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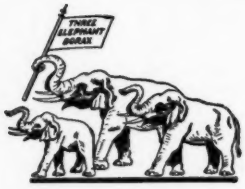

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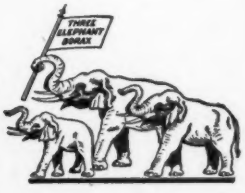

Pioneer Producers of Muriate of Potash in America

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington, D. C.

VOLUME XXVI NUMBER 10

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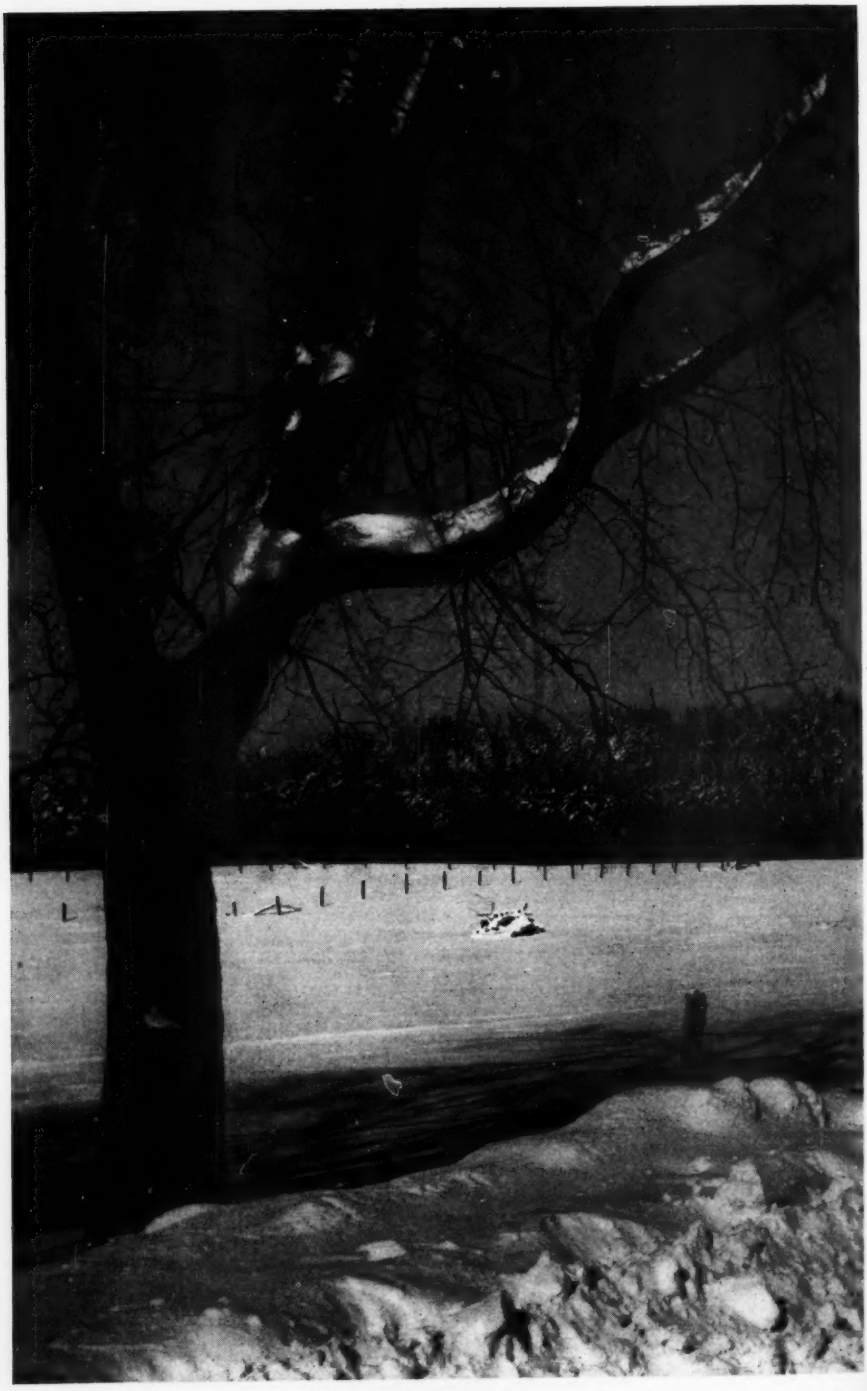

SILENT NIGHT

Better Crops with PLANT FOOD

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VOL. XXVI WASHINGTON, D. C., DECEMBER, 1942 No. 10

It's Holiday Season, so . . .

"The Same to You!"

Jeff McDermid

OUR TOWN, beleaguered and bewildered, has dug in for the duration. So as to make things clear in all this murk, I shall begin to retail our woes—(which is about all they retail now anyway.) I shall start at my own hearthstone.

"Ah, ha," you exclaim, "that's a pretty way to usher in the holiday season, reciting a mess of misery." "On the contrary," I reply, "misery loves company, and that's the only kind of company we can afford since my wife's relations all got A cards." (One of the war's compensations, by the way.)

"You see," I explain further, "being resigned to deprivation and content with makeshifts is a mark of civic pride and personal courage. They have done it for three years in Germany and France and England, and we've gotta prove to them how well we can take it too. The country that can deny itself the most in the shortest time is going to win. You ought to be thinking up more go-withouts and stop grouching."

"Well," the 'tother feller said, "that would be all right with me if they really stinted us on what is stintable. But how about them two items like cheese and gas," he says. "They are both very plentiful here in the Midwest, simply boiling over you might say; and yet we get rooked on cheddars and ethyl beyond all rhyme or reason."

"Now think patriotic for once," I come back. "Don't you realize they are cutting on gas to save rubber and holding back on cheese to save beer?"

Returning to my own crisis, I might begin with a review of the plight which my women folks are in when they look at their limbs encased in substitute

stockings. "They feel like wearing garden hose," says my daughter, "and look like a crocodile's hind leg!"

"That's next to nothing," I says in consolation. "Look at the bottoms of my pants. They resemble the fringed termination of Daniel Boone's all-weather outing suit, but I'm right proud to go primitive like our old heroes did. It's not only democratic as the dickens, but it's just like being at some masquerade party every day. No doubt as soon as we get the point system established on clothing, I shall limit myself to the utmost economy and finally wind up like our original aborigines—in loin cloth and turkey feathers. When that time comes, my idea is they should furlough some of the soldiers and let us deprived folks go over with the Injun outfits on. Europeans have heard so much about wild red men from the pulp magazines that they would scatter on sight."

"Anyhow, you might at least comb your hair, what there is of it, because neatness is not taboo as far as I know," she returned with feminine scorn. "You aren't deprived of being decent. It's better to be deprived than depraved anyhow," she said. "But you have to be careful because only one little letter stands between one word and the other. Remember your failings," she said. "Be true to your New England conscience. That's one thing they can't operate on."

"I'M not so sure about that either," I answered. "As long as the old scrap metal drive lasts, my conscience is in some danger of being mistook for an outcast relic and wind up in the junk yard."

"Speaking of your conscience," says my daughter, "I've lost my eyelash curler and that empty tooth-paste tube. Whattum I going to do?"

"It's an eye for an eye and a tooth for a tooth these days, dear heart," was my reply. "Those are Churchill's own words and we've got to stand firm against folderols." So she flounced out, hunting for the something to use instead of her favorite cold cream.

In my zeal to warm up to the cold topic assigned me, I shall pass by the kitchen door, where Ma is trying to tease a lumpy mass into a tasty dessert without enough sugar and spice. It is dangerous and foolhardy to enter that delicate domain without the makings of a meal in your pocket.

Nonchalantly, I sneak into my study sanctum to indulge in full-time worrying without outside competition. But the facts of life stare me in the face, even in this rookery. My old typewriter runs on one cylinder and makes as much noise as the farm bloc, and needs repair worse than a 1920 binder. But what slows me up most is the general crisis in situations.

IT has come to such a pass that I cannot strike a key without writing War or Bombs or Rations or Victory. The government has never actually issued a ban against utilizing some of my old means and methods of essay production. But the gentle public now grown berserk demands opinions, reviews, forecasts, and summaries dealing with the global combat—and what I know of the globe and the habits of its inhabitants in tropic seas and desert sands is only an echo of high school examinations.

I don't know an ornithopter from a helicopter; my ideas of the Garand rifle are as remote as Einstein's theory; and because I was in Class 4-A in 1917, I am unable to toss an iron hat onto the community scrap heap or call Irvin York "buddy." I cannot make you feel the thrill of sighting the Statue of Liberty for the first time from the outer harbor, as I have always been a naturalized inmate. If I had the imagination and the iron nerve of some of the loquacious columnists, I should fare better on reduced rations of rhetoric.

You can see at once what a fix I am in. I cannot resign because the federal treasury needs my donation next month, and the vast, panting public is

looking my way for inspiration. But writers are restricted by custom to a card-index of topics, beginning with Armaments and ending with Zones. Anything else is venial triviality, and suspected of being unpardonable lust for the outlawed Status Quo.

However, I have a slight ray of hope left. Gas stations may turn into livery stables in a couple of years, if there is enough leather and horse-flesh available. Thereupon, I shall trot out more of my erstwhile essays on nostalgia, in-

cluding the ancient moss-grown watering trough, the clanking blacksmith shop, the smelly harness store, and the joy of holding hands on a winter night on a hay-rack ride. Indeed that welcome era may transform me from a belated observer to an authoritative expert, much in demand where the listening is rapt and the victuals varied. When that time comes, I will feel as much at home as Claude Wickard at a hog-raiser's banquet.

Night illumination in Our Town was once confined to a glimmer at the gas stations to cheer some wayfarer out of fuel; a faint twinkle at the hotel and pool palace to entertain the convivial; and a murky glow in one corner of the calaboose for those who became too hilarious. Every mercantile spot was usually quite dark.

But lately you find most of the stores showing a faint, flickering light back in the rear where the boss is perched on a stool at the littered oak desk. Step in and ask him if his business is so fast that he is behind on his ledgers, and he'll probably throw something at you.

"See that hook where we used to file the sales slips and freight invoices? What dy'e 'spose jams it so full now? Nothing less than government orders, regulations, and priority memoranda. When I began the hardware business forty years ago, all the alphabet rigmarole we kept in mind was IOU, COD, and PDQ. But now we have ODT, WPB, OPA, AMA, BLS, NLRB, ICC, and Harry Hopkins!

"Today I go after something and find my shelves almost empty of galvanized ware, and then I dig open a government envelope and read that after January 1 we ain't goin' to get a single item of galvanized stock, except garbage cans, fire shovels, and wash tubs and boilers; and then, only half of what we sold during the depression. And there won't be any more stainless steel cutlery and coffee pots either."

"But, my good friend," I say in a futile attempt to soothe him, "the general orders restricting travel are apt to keep your customers trading right at home. It wasn't so long ago I heard country merchants complain about farmers driving to the larger places for supplies."

His reply is soon coming. "It might have helped us some if this gas-saving business had started before I lost my clerks to a defense plant and got swamped with red tape and them business-bustin' bulletins. It's got so that half my stock is froze stiff and the other half is all gone. But I got me a new set of lead pencils and a gallon of red ink, so I'm all set to figure my deficit down to the last dollar, and then give my note to the bank to settle my income taxes."

"Well, anyhow, it might be worse if we got conquered and starved out," is my hackneyed comment.

"Look here, Jeff," says the hardware man, "don't get any of us mercantile

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Wartime Contribution of the American Potash Industry

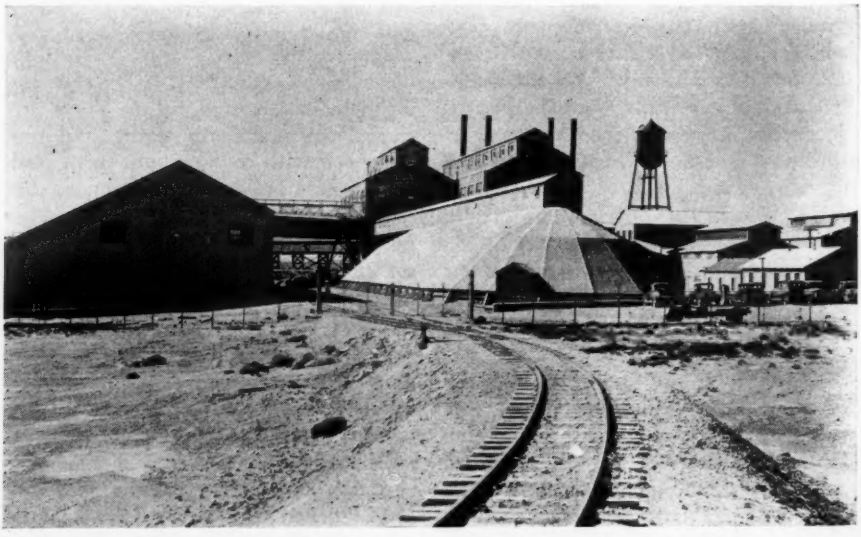
By Dr. J. W. Turrentine

Washington, D. C.

THE story of potash in North America has been told many times. It covers 30 years and is made up of many chapters, some of vision, hope, and success interspersed with others that deal with disappointments and heartaches. There is not one chapter, however, that deals with despair, for throughout the 30-year period there persisted a small group of legislators, scientists, and industrialists who remained steadfast in their faith that America would have a potash industry of sufficient dimensions, at least, to sever the ties of dependence on European sources of supplies. The story of how that independence has been achieved is often referred to as the romance of the American potash industry.

The current chapter deals with the industry's task of supplying potash salts called for by the war effort. The requirements of the war effort have been expanding month by month, both in tonnage and variety of potash salts, calling for an industry that must remain in a high state of mobility if its performance is to keep pace with that of the nation it serves. The process of expansion, however, is now ending due to the scarcity of essential materials of construction.

The present situation is a vivid contrast to that existing in 1914 and the succeeding four years of war. When war was declared in 1914, this country was totally dependent on the German potash monopoly for all potash salts, with scarcely the vestige of an industry



Storage facilities of potash mine and refinery of the U. S. Potash Company.

of its own. In consequence, the price soared from $35 to as high as $500 per ton of 50 per cent muriate. Fortunately, however, in 1911 surveys had been inaugurated by the federal Departments of Agriculture and the Interior to determine what we had in the way of raw materials from which potash could be extracted. All of the potential sources—minerals, natural brines, marine and dry-land plants, and industrial wastes—to which public attention was called by these surveys were promptly placed under exploitation and made to yield their quota to the wholly inadequate supply. By 1918, therefore, we were producing 20 per cent of our pre-war consumption which, with cautious use, engendered by the high prices persisting for the four-year period, enabled us to survive without serious disaster.

Modern mucking machine in operation in the mining of potash.

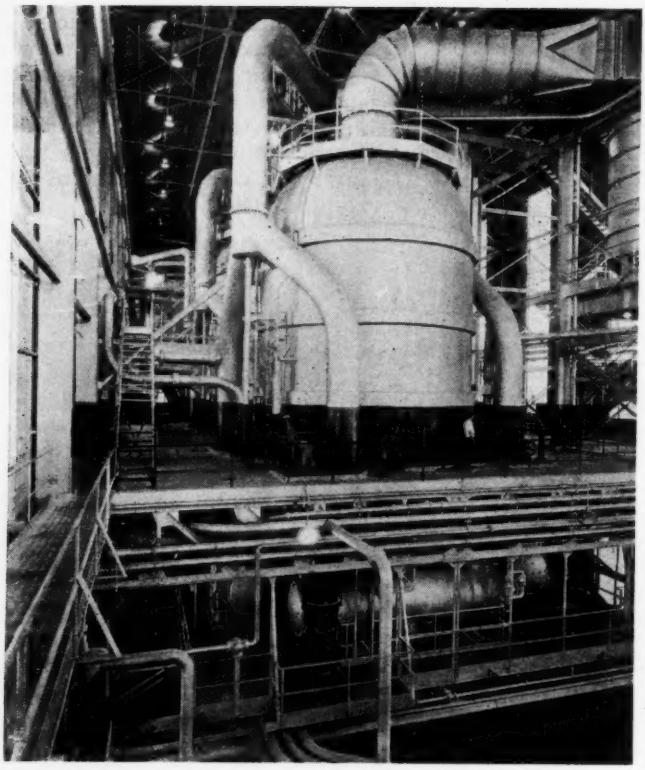
That experience taught several lessons which, learned by some, were ignored, tragically enough, by industrialists in other lines who have assumed the task of supplying the essential needs of the American public. Those lessons were and are:

1. The wisdom of foresight and planning.
2. The folly of relying on foreign sources of essential commodities, raw materials or finished products, however orderly their delivery and reliable they may appear to be.
3. The necessity of inaugurating technological research well in advance of an emergency, however remote, and keeping abreast of the most advanced techniques. If considerations of early profits on funds so expended are a deterrent to private initiative, the problems whose solutions are vital to our economic and social security must be assigned to the excellent research organizations endowed by the taxpayer and with staffs inspired by zeal for public service.

Potash research was inaugurated in 1911 and has continued up to the present time. The interval prior to 1914 was too brief to permit the development of techniques on which to establish competitive industries. In consequence, with the resumption of imports in 1919, 74 out of a total of 77 war emergency production units were forced to go out of business.

But research did not stop! Therefore, in 1939 when the second World War began and potash imports were again suspended, the interested public was told that national requirements would be taken care of by the domestic industry. In verification, there was no increase in price, nor has there been one since in the preferred standard grade of 60 per cent muriate.

Considerable skepticism greeted this statement when first made in 1939, for up to September of that year we had



Evaporator unit in the plant of American Potash and Chemical Corporation.

still been importing a considerable percentage of our potash requirements. What was not so generally known was that we had been exporting a substantial proportion of our production, which could and would be diverted back immediately into the domestic market; that we had large expansions in production capacity underway; that we had great reserves of unrefined run-of-mine salts readily available to more than equal any deficit in the refined salts that might develop; and that production of potassium sulfate, formerly largely imported, could and would be promptly expanded.

This forecast of 1939 has now been realized by two years of demonstrated performance (Figure 1). The contrast between the two crises, while dramatically illustrated by price stability, contains other features that illustrate the progress made: The 1914 price of $35 per ton now has its analog in the current price of $25 per ton. Thus, there has been the equivalent of a $10 reduction in the price of muriate. On the unit basis, the 1910-14 price was 71.4 cents; the current discount price of 60 per cent muriate is 47.1 cents, a reduction of 24.3 cents per unit K_2O. In 1914, the highest grade of that era was 50 per cent muriate; some 90 per cent of the total muriate of potash now being produced is of the 60 per cent grade, corresponding to some 97 per cent KCl which approaches the ultimate of refinement. Thus, there has been a 10 per cent increase in plant-food content. Involved also is a corresponding decrease in delivery costs. In 1914 domestic consumption approximated 250,000 tons K_2O a year. In 1942, it is estimated, we shall need some 580,000 K_2O; for in addition to the requirements of the continental United States, the domestic industry has assumed the task of supplying those of Puerto Rico, Hawaii, Canada, Cuba, and our "good neighbors" to the south. Since 1914 there has been an increase in demand of some 320,000 tons K_2O. Current production capacity in refined salts exceeds 600,000 tons K_2O. Thus, since 1914, refining capacity has increased from nothing to this figure, approximating a million tons of materials; in addition there is a demonstrated capac-

ity to produce and deliver over 40,000 tons K_2O in run-of-mine salts of 22 per cent or better K_2O content. Finally, since 1914, imports have declined from 100 per cent of our requirements to the current vanishing point.

The first major company to establish itself was the American Trona Corporation, now the American Potash and Chemical Corporation, which as early as World War I produced potassium chloride from the brine of Searles Lake, Calif. Since that time, through dint of continuous and persistent research, it has undergone development after development, added product after product from that highly complex brine which is the raw material processed, to its present state of constituting one of the outstanding chemical achievements of this country. Here is to be found phase-rule chemistry in its most intricate form applied on the plant-wide scale and mechanized with the greatest precision.

Following the discovery in 1926 of subterranean deposits of high-grade potash salts underlying an area near Carlsbad, N. Mex., the United States Potash Company entered that field and thus became the American pioneer in the mining and refining of a raw material from such a source. Its mine was equipped with the latest mechanical devices and its refinery in accordance with the best technology then developed. Thus was realized for the first time the dream of an American potash industry similar to that of Europe, long recognized as the ideal.

Then followed in the same field the Potash Company of America with a mine thoroughly mechanized and a refinery built to apply the flotation process, the first industrial application to a water-soluble ore of the familiar flotation principles. This was followed in turn by the mine and refinery of the former Union Potash and Chemical Corporation, now amalgamated with the International Minerals and Chemical Corporation, again with a mechanized mine and a refinery employing flotation methods, in part at least. These four are the major factors of the American potash industry.

Intermediate in scale of production is the plant of Bonneville, Ltd., near Wendover, Utah, where the raw material is a brine found in the clay stratum underlying the salt crust covering the Bonneville Flats or Salduro Marsh of the Salt Lake Basin. Here solar evaporation is employed to yield a mixture of crystalline sodium and potassium chlorides, subsequently separated by flotation. Minor sources are the incinerator ash of U. S. Industrial Chemicals, Inc., of Baltimore, whose raw material is the evaporated and burned distillery waste from molasses fermentation, and the fractionally precipitated cement dust of the North American Portland Cement Company at Hagerstown, Md. The natural brines

Heavy equipment for removing potash salts from large stock piles in storage, American Potash and Chemical Corporation.

Crystallizing house and evaporator buildings of American Potash and Chemical Corporation.

of Searles Lake and Salduro Marsh and the by-products, cement dust and distillery waste, were utilized as sources of potash during the first World War.

While steadily increasing their capacities, the major producers have added other chemicals to their list of products and thus effected diversification and full utilization of the constituents of their raw materials. Outstanding in this respect is the American Potash and Chemical Corporation with a list of products that includes potassium chloride of some 98 per cent purity designed for the fertilizer trade and a product further refined for the chemical trade, as well as potassium sulfate, sodium sulfate, sodium carbonate, sodium borate decahydrate, sodium metaborate, boric acid, bromine, potassium, sodium, and ammonium bromides, and lithium salts. The recovery of tungsten is now undergoing study.

The potash ores of the Carlsbad area are too free from impurities to admit of such an array of products; yet under production are potassium chloride of several degrees of purity and crystal size, potassium sulfate, sulfate of potash-magnesia, potassium hydroxide, potassium chlorate, and magnesium chloride.

As recently as 1938 we still imported 65,000 long tons of potassium sulfate from Europe. At that time we already had some production from the interaction of potassium chloride and sulfuric acid. This conversion was promoted by the Potash Company of America in collaboration with producers of salt cake, potassium chloride being substituted for sodium chloride in that manufacture. Later the American Potash and Chemical Corporation entered upon this production through the interaction of potassium chloride and burkeite, another practical application of the phase rule. In 1939 this company announced its willingness to expand initial production to provide the essential requirements of agriculture, and proceeded to do so. This was followed in short order by the completion of the refinery of the International Minerals and Chemical Corporation with the production of potassium sulfate from langbeinite (a natural potassium-magnesium sulfate) by interaction with potassium chloride. As the result of these activities, keen apprehension as to the adequacy of wartime supplies of this form of potash so essential

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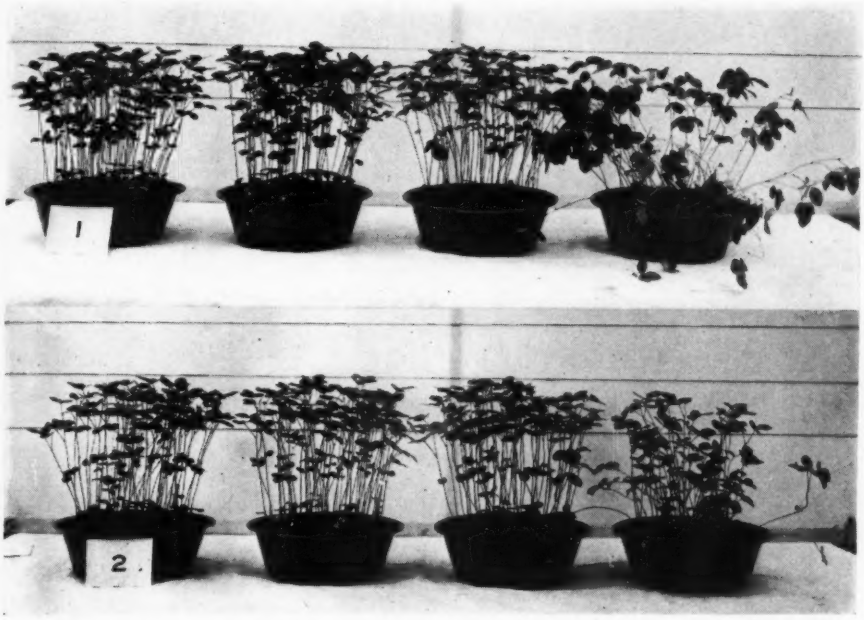

Weak stems in soybeans, like lodging of oats, may be induced experimentally under variable nutrient levels. Left to right, moderate to excessive potassium; above, high calcium; below, low calcium.

A Preliminary Study Of Lodging of Oats

By H. E. Hampton

Agricultural Experiment Station, College Station, Texas

AS TIME goes on, more and more evidence is accumulating to point to the relation between nutrient balance in the soil on the one hand and plant composition and resistance to disease and insects on the other. Certain other plant reactions, such as lodging in small grains, have likewise been associated with the nutrient levels in the soil.

The possible significance of the calcium-potassium ratio in the soil has been suggested by Albrecht (1) as an aid in a better understanding of plants in relation to soil development and soil fertility. A survey of orchard practices and mealybug injury to apple trees in Virginia has led Schoene (10) to the conclusion that increased insect damage follows a slight deficiency of potash in proportion to nitrogen following several applications of nitrogenous fertilizers in an attempt to improve fruit color.

It is generally accepted that lodging of cereals is caused by nitrogenous overnutrition, although the actual role of the nitrogen in this connection is not well known. Davidson and LeClerc (4) found that applications of sodium nitrate caused lodging of cereals. This

trouble was associated with low ash and silica content of the straw. The work of Welton (12) indicated the same effect of nitrogen, but his study showed lodging more closely correlated with low lignin content than with low ash or silica. Davidson and Phillips (5), on the other hand, concluded from their work with nitrogen-induced lodging in wheat that high and not low lignin content is the cause of lodging.

It has been observed by Tubbs (11) that when potash is limited, wheat tends to lodge, especially in wet weather. He concludes that potassium is essential to the production of an efficient mechanical tissue. However, Purvis (9) studied the structure of the stems of a grass (Dactylis glomerata) and formed the opinion that potassium does not effect an anatomical strengthening of the stem, but that its effect is more probably attributable to a change in physiological condition or chemical composition.

Lodging has been frequently observed in small grains growing on the soils of heavy texture in the Missouri River bottoms. The lodging usually occurs on the heavy, dark-colored clay soils. These soils are presumably well supplied with potassium, but because of the nature of the clay minerals that compose a rather large portion of the soil mass and the high calcium content, there is a possibility that the potassium present is fixed in a difficultly available state. Preliminary field trials were carried out for the purpose of finding whether or not the use of potassic fertilizers would remedy the cause of lodging. As a consequence of the observations by Tubbs, Welton, and others and the clay texture of the soils, it was considered advisable to lay out plots in which the treatments consisted of varying levels of potassium added as muriate (60% K_2O). In addition to the potash, some of the plots received phosphorus as "treble phosphate" (45% P_2O_5). The treatments are shown in Table 1.

In the fall of 1940 the plots were seeded to wheat, an extensive crop on the heavy alluvial soils along the Missouri River, but because poor stands were obtained, the plots were planted to oats the following spring. Contrary to expectation, the oats on the high-potash plots lodged badly, while those receiving no additional potash stood up well. An analysis of the straw and of the soil was made in an attempt to explain the reason for the lodging.

TABLE 1.—TOTAL N, AND EXCHANGEABLE CA AND K IN SOILS AS AFFECTED BY ADDITIONS OF KCL, WITH AND WITHOUT ADDED PHOSPHORUS

Plot	Treatment per acre	Clay soil			Sandy soil		
		Total N %	Exch. Ca mg./ 100gm. soil	Exch. K mg./ 100gm. soil	Total N %	Exch. Ca mg./ 100gm. soil	Exch. K mg./ 100gm. soil
1	400 lbs. KCl 150 lbs. P_2O_5 (45%)	.22	529.1	72.3	.16	325.6	44.1
2	400 lbs. KCl	.22	507.2	61.5	.18	339.3	80.3
3	200 lbs. KCl 150 lbs. P_2O_5 (45%)	.21	499.8	59.2	.16	323.2	55.3
4	No treatment	.21	509.8	65.2	.15	316.2	21.9
5	200 lbs. KCl	.21	516.0	64.7	.18	490.6	58.5

The soil on each plot is not entirely uniform; one end of each plot contains a larger proportion of sand than the other. For this reason two samples of plant material and two of soil were taken from each plot and analyzed separately. That this separation was justified is shown by the results of the analysis.

The soils and oat stems were analyzed for total nitrogen by the method of Kjeldahl-Gunning-Arnold as modified by Murneek and Heinze (8). Finely ground samples of the plant material were digested by the wet ashing method (6), and calcium and potassium determined in the digested samples by the methods described by Kolthoff and Sandell (7). The same methods were used for the determination of calcium and potassium in the ammonium acetate leachate of the soil samples. A modification of the method proposed by Crampton and Maynard (2) was used for the estimation of the lignin content of the plant material.

From the results of the soil analyses given in Table 1, it will be seen that the heavier soils contain more total nitrogen, exchangeable calcium, and in general, more exchangeable potassium. Neither the applied potash nor the added phosphate influenced the total nitrogen. In the clay soils, there was little relation between replaceable soil potassium and potash added; however, the relationship was much more evident in the sandy soils. The clay soils are evidently well saturated with bases and the potassium supplied was presumably fixed in a non-replaceable form. The lighter soils, on the other hand, are not fully saturated and have less ability to fix potassium, therefore, they show an increase in exchangeable potassium with larger amounts of potash added.

TABLE 2.—PLANT CONTENTS OF TOTAL N, CA, K, AND LIGNIN IN RELATION TO KCL ADDED WITH AND WITHOUT ADDED PHOSPHORUS

Plot	Treatment per acre	Clay soil				Sandy soil			
		Total N %	Ca %	K %	Lignin %	Total N %	Ca %	K %	Lignin %
1	400 lbs. KCl 150 lbs. P_2O_5 (45%)	.44	.20	3.23	25.5	.60	.14	2.88	24.7
2	400 lbs. KCl	.53	.17	3.44	24.6	.67	.19	2.93	24.2
3	200 lbs. KCl 150 lbs. P_2O_5 (45%)	.50	.22	2.33	32.4	.45	.14	2.96	31.6
4	No treatment	.53	.23	2.41	33.5	.53	.18	1.84	34.1
5	200 lbs. KCl	.49	.19	2.31	34.0	.41	.18	2.74	34.5

The results of the plant analyses are given in Table 2. With the exception of the oats from the sandy soils receiving high applications of potash, the treatments had no significant effect on the plant content of total nitrogen. The samples from the sandy soils of Plots 1 and 2 contained nearly 18 per cent more nitrogen than oats from the other plots, and in addition, these were the only samples that showed damage from rust and smut.

The percentages of calcium and potassium in the plant samples followed very closely the ability of the soils to supply these elements. This relationship was particularly evident in the case of potassium. The close relation-

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The Place of Boron In Growing Truck

By A. G. B. Bouquet

Oregon State College, Corvallis, Ore.

CERTAIN plant-food elements, such as boron, have usually been classified as being of minor value because of the relatively small amounts of them used by plants and because, until recently, but little was known of their function in growing agricultural crops.

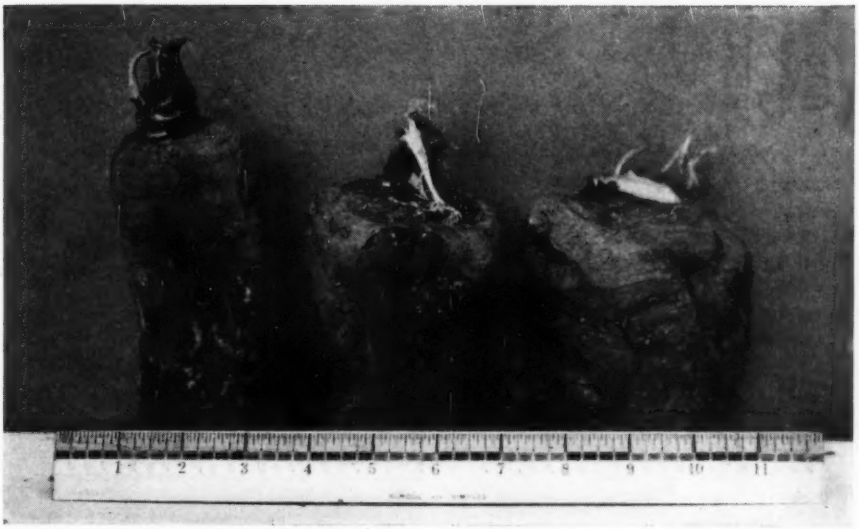
It is particularly interesting to note, therefore, that probably no single plant-food element has received as much attention in recent years as one of these so-called minor elements, namely boron. Given but little consideration a few years ago, boron has now taken a place among plant-food elements as being highly important and essential to the normal plant growth of many economic crops. This is especially true with vegetable crops. Moreover, the number of crops for which boron is now considered an essential element covers a wide range. The list includes apples, alfalfa, apricots, avocados, barley, beans, beets, blueberries, broad beans, cabbage, carrots, cauliflower, celery, citrus fruits, corn, cotton, cloves, cucumbers, currants, grapes, gloxinias, hops, kohlrabi, legumes, lentils, lettuce, lilies, oats, onions, pecans, peaches, peas, prunes, potatoes, radishes, rice, rutabagas, sorghum, soybeans, spinach, strawberries, sugar beets, sugar cane, sunflowers, swedes, sweet potatoes, tobacco, tomatoes, turnips, walnuts, and wheat. All of these crops at some time or other have received attention to a greater or less extent in the relation of boron to their growth.

More investigations have been made with sugar beets and the use of boron in growing them than any other single crop. In fact it was the publication in 1931 by Brandenburg, a German investigator who discovered the heart-rot disease of sugar beets to be due to boron deficiency, which initiated a widespread interest in the possible relation of boron to other plants and their disorders. A standard application in Germany for sugar beet heart-rot was the use of borsuperphosphate, using 5 parts of borax and 95 parts by weight of 18 per cent superphosphate.

World-wide Interest

Some 13 countries of the world have participated in investigations of boron in sugar beet production, including Belgium, Canada, Czechoslovakia, Finland, France, Germany, Great Britain, Italy, the Netherlands, Russia, Sweden, Switzerland, and the United States. Others that have conducted investigations with boron in its relation to crop production include Australia, New Zealand, Africa, Brazil, Hawaii, India, and Poland.

According to Purvis (1), one of the earliest investigators of the use of boron in this country, areas in the United States reporting boron-deficiency symptoms include states widely scattered over the country as a whole, but particularly centered along the Atlantic seaboard, around the Great Lakes, and in the Pacific Northwest. These states include Alabama, Connecticut, Florida, Idaho, Indiana, Maine, Maryland, Massachusetts, Michigan, Mississippi, Montana, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oregon, Rhode Island, South Carolina, Vermont, Virginia, Washington, West Virginia, and Wisconsin.



Boron deficiency in carrots may cause both canker and exterior splitting.

Vegetable crops mentioned in these states as having been investigated in their relation to boron include beets, broccoli, cabbage, carrots, cauliflower, celery, corn, eggplant, kale, lettuce, mustard, peppers, radishes, rutabagas, spinach, sweet potatoes, tomatoes, and turnips.

By far the greater number of investigations of the value of boron in growing vegetables has taken place within the last five or six years. This is true not only in the United States but also in other countries.

One of the earliest investigators was an Englishwoman, K. Warrington (2), who reported in 1923 on the relation of boron to the growing of broad beans. This investigator has since reported briefly on the requirement of boron in growing carrots. Diseases in sugar beets were studied on a basis of boron deficiency in Sweden, France, Belgium, and Ireland in 1935, and it was found in Sweden that addition of boron to the soil increased the yield and sugar content of the beets. The Belgian Institute for Beet Improvement carried out a program of study on boron deficiency in beets in 1935, and similar work was carried out in Ireland. In the United States boron deficiency in sugar beets was fairly well established in Michigan in 1932.

In 1929 Johnston and Dore (3) published in "Plant Physiology" on the subject of "The Influence of Boron on Chemical Composition and Growth of Tomato Plants," but thus far there has been little, if any, boron used in growing this vegetable.

In August 1935, Purvis and Ruprecht (4) of the Florida Agricultural Experiment Station published a press bulletin on "Borax as a Fertilizer for Celery," and 10 pounds of borax per acre were advised. Again in 1937 (5) these authors published the first bulletin on boron deficiency of a vegetable crop. This was a progress report on the use of boron in prevention of celery stem-crack.

In the spring of 1936, the Department of Vegetable Crops of Oregon State College sent S. E. Fish of Eugene 10 pounds of borax for his celery, and a like amount was also sent Henry Oman, a celery grower of Milwaukie, Oregon. Both of these growers who had complained of celery stem-crack have been regular users of borax since that time. At about the same time, in

There may be an interior breakdown as well as exterior canker when a deficiency of boron exists.

1936, Zimmerley and Parker of the Virginia Truck Experiment Station corrected boron deficiency on celery by an application of borax at the rate of 10 pounds per acre.

In the latter part of 1937, W. L. Powers, Soil Scientist at Oregon State College, conducted some greenhouse experiments showing that 30 pounds of borax prevented beet canker. Field trials were conducted by Powers and the author in 1938 and a report was presented in Oregon Station Circular of Information 195. These constituted the first field trials in the use of boron for the control of canker of table beets. Since that time practically every field of table beets in Oregon grown for canning has received applications of boron.

Almost all beet growers are familiar with the symptoms of canker of the beet, sometimes called internal breakdown, internal black-spot, dry rot, girdle, etc. Several years before the use of boron in this regard was known, this malady was photographed and described by the Oregon State College Department of Horticulture. In most beet plants affected by boron deficiency there is a relatively prostrate or downward hang of the leaves and a dead or injured growing point.

Beets have been canned in Oregon to the extent of over 300,000 cases annually, and therefore the use of borax for this crop is important. Losses due to beet canker have possibly averaged from 8 to 10 per cent per year, although in individual fields the losses have been considerably higher. Evidently the beet has an unusually high requirement for boron, or, in other words, the plant has a high degree of susceptibility to injury from boron deficiency compared with other crops. Since the value of boron for beets has been established, particular attention has been paid to the amount of borax to be applied and the method of placement.

In contrast to the comparatively small amounts of borax advised in the early years of experimentation along these lines, it is now felt that if a fertilizer in which boron is to be added is broadcast over the beet area, it will be advisable to apply 500 pounds or so of the fertilizer together with 50 pounds of borax. If the fertilizer is side-dressed, the amount would not ordinarily exceed 200 to 300 pounds with 30 to 40 pounds of borax.

In Wisconsin (6) no toxicity has been found in the use of larger amounts of borax broadcast to the extent of 80 to 100 pounds per acre, especially in alkaline soils. One hundred pounds were applied in Wisconsin in 1939 and 1940, 1½ inches to the side of the row on the same level as the seed, and the recommendations in that State are to the effect that 60 pounds broadcast is a safe amount. Apparently, in the Wisconsin experiments there was little difference in the choice of efficiency between broadcasting and side applications where 60 pounds per acre were used. This State also reports that 40 pounds of borax on a beet field lasted two years, but 20 pounds per acre for two years was insufficient. In other words, the larger amount of borax had a longer effect.

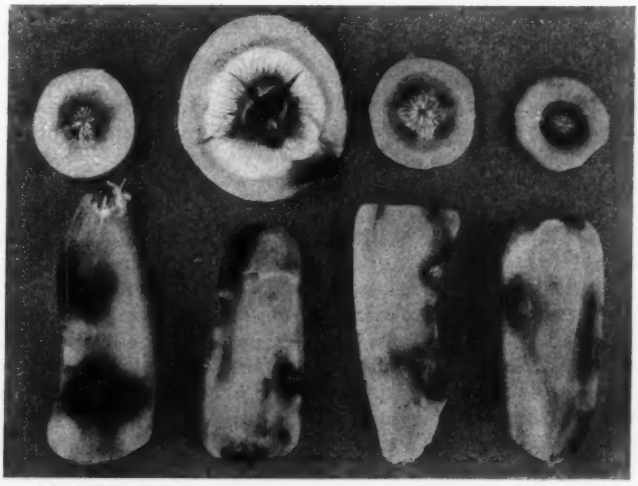
Based on his investigations, W. L. Powers (7) opines that boron-deficient soils should receive boron every two or three years. It was further mentioned in the Midwest investigations that a grower could get reasonably good control of canker by a single top-dressing at the side in mid-July, the data given being as follows: 83.7 per cent black spot in untreated soil, 5 per cent from the use of 20 pounds in July, 1.4 per cent from the use of 40 pounds, and no injury from the use of 60 pounds.

It is likewise interesting that in testing the susceptibility of different varieties of beets to canker, it was found in Wisconsin that there was a marked difference in susceptibility. The Good-for-All variety showed considerable black-spot injury where, on the same land, the Detroit Dark Red was practically free from injury. Such findings have also been confirmed by field and greenhouse experiments at Corvallis and Eugene, Oregon.

It has been stated that the factors contributing to beet canker are these: First, the beet has a higher boron content than many other vegetable crops; second, little if any manure has been used on beet ground; third, in correcting the reaction of the soil, increased liming has brought increased percentage of injury; and fourth, some soils have experienced moisture deficiencies. Other reasons given for boron deficiency are the present-day use of pure synthetic fertilizers and the problems of soils and their leaching.

Before proceeding to a discussion of symptoms of other vegetable crops for which boron is now used, the values of boron for vegetables might be enumerated as follows: Elasticity given to cell membranes, increased resistance to damage from drought, improvement of conducting tissues, inducement of normal leaves, prevention of stem cracks and hollow areas in roots, likewise in preventing discoloration of flowers such as cauliflower and in correcting miscellaneous characters of mal-

(*Turn to page* 37)



Other indications of boron deficiency in carrots are black spot and water core.

Nitrogen for Crops From Winter Legumes

By W. F. Watkins

U. S. Department of Agriculture, Washington, D. C.

NITROGEN long has been recognized as an essential plant-food element in crop production. In war time, the use of chemical nitrogen is equally important but more difficult to obtain for growing crops because of the amount needed for military purposes. Fortunately, the nitrogen needed to maintain agricultural production can be obtained from two sources, that available for use in commercial fertilizers and the amount that can be obtained by growing legumes. In view of this situation, it is desirable to review some of the literature containing information on the effect of nitrogen from these two sources on crop production.

The agricultural economy of the Southeastern States is closely tied up with the use of nitrogen to maintain crop production. This area consumes from 60 to 70 per cent of the nitrogenous fertilizer used in the United States. The soils in this area are not only low in nitrogen content, but it is not possible to build up and maintain the soil nitrogen content comparable to the nitrogen content of the Central Corn Belt soils. The accompanying figure shows the average 1935-39 consumption of nitrogen in commercial fertilizers by States. On the other hand, the systems of farming and adapted legumes in the Southeast present a problem different from other sections of the country. The seasons are long and it is possible to grow cash, soil-depleting crops during the summer, and a soil-building legume during the fall and early spring. To date, the use of winter legumes has not been sufficiently extensive to make a major contribution to the agricultural economy of the area. Has this been due to the ineffectiveness of these legumes in obtaining satisfactory crop yields, the economies of growing legumes, the lack of income, or to other factors?

The area most seriously affected from a shortage of nitrogen fertilizer stretches from the fertile delta of the Mississippi River through the Coastal Plain and Piedmont sections of the Southeast, and north into Virginia. In this same area, winter legumes such as Austrian peas, hairy and common vetch, and crimson clover generally can be grown.

Dependent Upon Soil Management

Throughout this area, cotton is the principal cash crop for a large rural population with few acres of cropland per person. The farms are small, with less than one-half the land in cultivation, and the area has been farmed for many decades. The virgin fertility has been depleted and much of the original surface soil has been washed away. The crops produced depend on a soil-management program that supplies the elements of fertility, rather than the reserve that may be in the soil.

The most important fertility element throughout the area is nitrogen. State experiment stations have conducted many experiments comparing the effect of winter legumes and commercial nitrogen on the yield of cotton, corn, and other crops. In the following paragraphs some brief summaries of the results obtained are presented, including the effect on single crops and all crops in the cropping system.

The average winter legume crop contains 50 to 100 pounds of nitrogen per

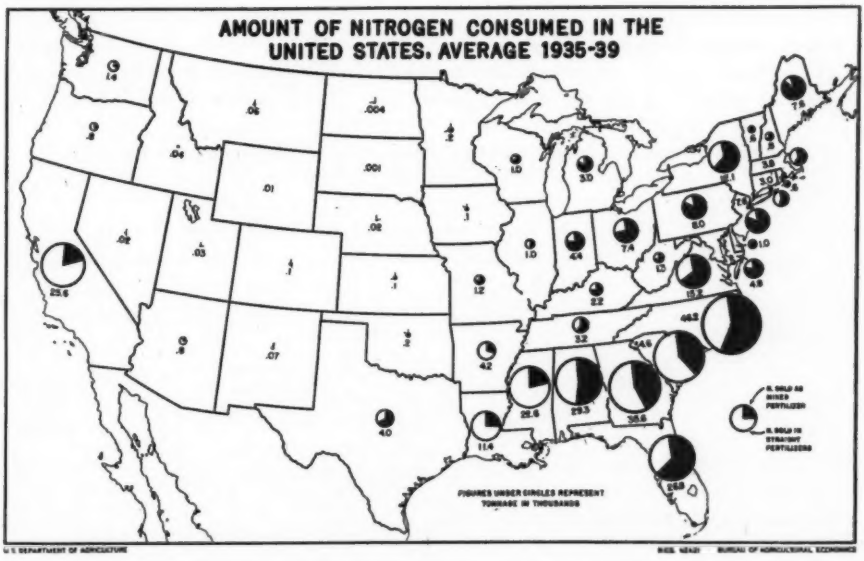
acre, and maximum cotton yields are usually obtained with 45 to 50 pounds of commercial nitrogen. In the Mississippi Experiment Station Report for 1940, "Cotton receiving its nitrogen from winter legumes and its phosphorus and potash from 400 pounds of 0-8-4 produced almost identical yields with cotton receiving 400 pounds of 6-8-4 with no winter legumes."

Soil Treatment	Yield of seed cotton per acre (6-yr. Av.)
400 pounds 6–8–4.....	1,252 lbs.
Hairy Vetch, plus 400 pounds 0–8–4.....	1,305 lbs.
Austrian Peas, plus 400 pounds 0–8–4.....	1,244 lbs.
Crimson Clover, plus 400 pounds 0–8–4.....	1,213 lbs.

16.9 bushels, and the yield with 30 pounds of nitrogen has been 31.4 bushels—an increase of 14.5 bushels, or about 1 bushel of corn for every 2 pounds of nitrogen.

Experiments dating back to 1896 on different sources of nitrogen have received major emphasis in Alabama. Particular emphasis has been placed on the influence of winter legumes on the yield of succeeding crops, the residual effect of legumes, and the influence of fertilizers, especially phosphate, potash, and lime on the yield of legumes.

Ten-year results on cotton and corn grown continuously gave average yields, without legumes, of 349 pounds of seed cotton and 8.2 bushels of corn; and yields, with legumes, of 1,041 pounds of seed cotton and 19.4 bushels of corn —an increase of 692 pounds of seed cotton and 11.2 bushels of corn. In a three-year rotation of corn, cotton, and


AMOUNT OF NITROGEN CONSUMED IN THE UNITED STATES, AVERAGE 1935-39
FIGURES UNDER SINGLES REPRESENT TONNAGE IN THOUSANDS
U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF AGRICULTURAL ECONOMICS

On Mississippi upland soils, fertilization also is necessary for corn yields large enough to be economical. The value of winter legumes has not been satisfactory because of poor stands obtained; hence, the nitrogen was not supplied. The 6-year average yield of corn with no fertilizer has been only

oats, each plot received the same application of phosphate and potash. Where legumes were included in the rotation, the yield of seed cotton per acre was increased 397 pounds, and corn, 24.2 bushels.

The residual effect of turning under vetch was obtained in 1928 when the

vetch crop failed. During the three previous years a good growth had been incorporated in the soil; and in 1928, with an 18-inch spacing, the corn yielded 34.6 bushels, an increase of 21.7 bushels for the legume. In the same year the increase in corn yield from 200 pounds of nitrate of soda was 12.1 bushels, and from 400 pounds of nitrate of soda was 23.9 bushels. The average increase in yield of seed cotton, where legumes were turned under in 1925 to 1927, was 224 pounds per acre.

In Alabama experiments, the application of superphosphate and lime increased the yield of winter legumes. In a three-year rotation, crop yields were only slightly increased with phosphate and potash, without legumes; but with legumes, the yields were increased by 293 pounds of seed cotton and 11 bushels of corn per acre.

The following table shows the yield of seed cotton and corn with different sources and amounts of nitrogen.

The rotation of cotton-vetch-corn, with 225 pounds of nitrate of soda on the cotton, increased the yield of seed cotton 673 pounds, and corn 23.4 bushels per acre. It is possible that vetch turned under for the cotton would have given profitable yields, but in actual practice only a limited acreage can be planted and turned under at the proper time.

The successful growing of cotton on average Georgia soils, according to experiments, requires that it be supplied with 30 to 36 pounds of nitrogen, 32 to 48 pounds of phosphoric acid, and 24 to 36 pounds of potash per acre. The supplies of nitrogen may be obtained from commercial fertilizer or legumes. Twelve years' results at the Coastal Plains Experiment Station, Tifton, Georgia, gave an average yield of corn of 47.3 bushels, and of seed cotton of 1,303 pounds, with no nitrogen fertilizer and winter legumes; and a yield of corn of 48.0 bushels, and of seed cotton of 1,410 pounds, with a complete fertilizer containing nitrogen.

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AVERAGE ANNUAL YIELDS OF SEED COTTON AND CORN PRODUCED IN VARIOUS CROPPING SYSTEMS, 1930–1935

Cropping System[1]	One acre of cotton and one acre of corn					
	Yields per acre		Value of crops less cost of fertilizer and legume[2]	Increase over cotton-corn. No nitrogen	Cost of increase	
	Seed cotton	Corn			Cotton per pound lint	Corn per bushel
	Lbs.	Bus.	$	$	¢	¢
Cotton—Corn. No Nitrogen..	795	16.3	36.36	.....	.....	.....
Cotton—Corn. 36 lbs. Nitrogen to each.....	1,325	31.9	61.82	25.46	2.1	24
Cotton—Vetch—Corn. No Commercial Nitrogen.....	1,008	34.4[3]	55.96	19.60	.....	14
Cotton—Vetch—Corn. 36 lbs. Nitrogen to Cotton....	1,468	39.7[4]	74.61	38.25	1.7	11

[1] 600 pounds of 0-10-4 were applied annually to each plot; where vetch was grown, this fertilizer was applied in the fall.
[2] The seed cotton was valued at 4 cents per pound, the corn at 75 cents per bushel, superphosphate at $16 per ton, muriate of potash at $33, nitrate of soda at $33, and vetch at $2.50 per acre.
[3] Average green weight of vetch turned under was 7,810 pounds per acre.
[4] Average green weight of vetch turned under was 10,475 pounds per acre.

Fertilizer made the difference on this barley. Left, no fertilizer; right, phosphate, and potash in the form of 100 lbs. of potassium metaphosphate per acre.

Scientists Say . . .

By G. E. Langdon

University of Wisconsin, Madison, Wis.

SOIL scientists at the University of Wisconsin record many findings of interest to growers in their annual report.*

Many fields are in critical need of phosphate in the silt loam areas of Wood and Marathon counties, as well as in the nearby Marathon silt loam sections, according to indications found by L. B. Nelson and A. R. Albert. Lack of potash on these lands generally is less serious, but nevertheless important.

Soil samples collected by F. L. Musbach and Nelson on many of these farms showed the available phosphorus commonly is at the extremely low level of about 10 lbs. per acre, while the available potassium usually ranges from 120 to 130 lbs.

Nelson and Albert carried out fertilizer trials directly on some of these farms in 1940 using barley as a test crop.

On level Spencer silt loam, barley responded remarkably to fertilizer. Whereas the yield was less than 21 bus. per acre without fertilizer, it was about 50 bus. with 289 lbs. of 20% superphosphate and 71 lbs. 50% muriate of potash per acre. Minor elements such as boron, magnesium, and manganese were of no benefit.

On the rolling phase of Spencer silt loam, unfertilized barley yielded 25 bus. per acre. Phosphate alone increased yields by 10 bus., potash alone increased them by 5 bus., and the two together increased yields about 15 bus.

* "What's New in Farm Science." Annual Report of the Agricultural Experiment Station, University of Wisconsin, 1941.

Barley yields on Marathon silt loam were nearly 49 bus. per acre without fertilizer, 66 bus. with phosphate alone, and about 69 with both phosphate and potash. On this soil, which is better drained and more suitable for barley than the Spencer type, smaller applications of fertilizer sufficed to bring about maximum yields.

On the basis of these trials with barley as a test crop, the best recommendations that can be made at present are 250 lbs. per acre of 0-20-10 or 0-20-20 for Spencer silt loam and 125 lbs. per acre for Marathon silt loam, or the equivalent in fertilizer of other analyses. It may be necessary to modify these recommendations as more data accumulate.

Phosphate and Potash Help Crops in Door County

Seventeen years of research at the Peninsular experiment farm near Sturgeon Bay have indicated that crops respond to phosphate and potash in addition to manure.

The soils on this farm, as in many sections of Door county, are shallow, being underlain by limestone at depths ranging from 7 inches up. This allows them to dry out rapidly, and drought usually prevents any extremely sharp increase in yields from fertilizer.

Nevertheless, the response is enough so that the better treatments do pay out, particularly if the fertilizer is purchased at reasonable prices and the crops efficiently fed to good livestock. Fertilizer has another advantage in making it possible to use the crops and rotations which conserve the soil—and that is a critical matter when there is only a shallow layer of soil which needs to be held as cover for the underlying rock.

These are the findings of A. R. Albert, made on land which is manured once in each five-year rotation consisting of corn, oats, and three years of alfalfa:

1. Superphosphate is the most effective and profitable fertilizer for the shallow soils.

2. Potash further increases yields when used along with superphosphate.

3. Raw rock phosphate helps very little, and probably is not a wise investment on the non-acid or slightly acid soils.

4. Ground limestone is of no value on non-acid soils where it is only 20 inches or less down to limestone bedrock.

On the basis of these findings, Albert recommends 200 to 250 lbs. per acre of 0-20-20 or 0-20-10, to be applied with a grain-fertilizer drill at the time small grain and legume seeding are sown. If the fields have been well manured, and experience shows that legumes thrive on them, it may be satisfactory to modify this program by using superphosphate alone.

Sugar beets responded very well to heavy fertilizer applications in Fond du Lac and Kenosha counties in 1940, K. C. Berger and E. Truog found.

The fact that rainfall was plentiful last year no doubt helped fertilizer produce outstanding results which would not be equalled in a dry season. Nevertheless it is wise to be consistently liberal with fertilizer for cash crops which are capable of yielding a high return. Such a practice not only stands a chance of "paying out" very well the first year, but also puts the land in shape to produce excellent crop yields for several years to come.

Fertilizer trials were carried out in cooperation with the Menominee Sugar Co. and the Superior Sugar Refining Co. on a Superior clay loam at Fond du Lac and Carrington silt loam near Kenosha. The Superior soil was fertile and high in lime, while the Carrington silt loam was less fertile and somewhat acid.

Applying 100 or 200 lbs. of 3-12-12 fertilizer per acre at the side of the seed produced a good response, but did not bring about maximum yields. Broadcasting 500 lbs. of potash to the acre, in addition to using a side-row application,

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PICTORIAL

WINTER

CHORES

Above: More than 1,600 turkeys were on range on the Harry Satchell farm in Henry County, Iowa, when this picture was taken.

Below: To save work this Lee County, Iowa, farmer shocked his corn handy to the feed lot.

The Editors Talk

Agriculture 1942

Agriculture in 1942 was called upon to make far-reaching adjustments in line with the war needs of the United Nations. In the United States, this meant many changes in the agricultural plans and programs from a peacetime, or at most a national defense concept, to a war basis. In Canada, it meant the intensification of a war program already under way.

Farmers were called upon to make shifts in crop acreages and even in the crops they had planned to grow. In the United States, the crop programs already drawn up by the Department of Agriculture were revised after Pearl Harbor and called for greatly increased agricultural production. This did not apply to all agricultural products, but was directed mainly at the edible oil crops such as peanuts, soybeans, flax, dairy and animal products, which in turn called for increased forage production, vegetables to take care of greatly increased domestic needs, and canning crops to take care of the needs of the armed forces and of the United Nations. With large stocks of wheat in both Canada and the United States, any increase in wheat production was discouraged, as was also the production of short staple cotton. The production of long staple cotton was encouraged, as this was urgently needed in certain military and commercial lines. A slight increase in tobacco acreage was called for to take care of the expected increase in demand.

Farmers met the demands made on them, increasing the acreages of the desired crops and holding down the other crops. They met increasing shortages of labor by improving their practices, by using more fertilizers than ever before, and all the machinery they could get. The whole family got out in the fields and worked; white collar workers from the city helped the best they could in many places; factory workers and school children were given time off to help with the harvest; and weather on the whole was favorable. As a result, North America had the highest agricultural production in its history.

Along with good yields farmers received high prices for their products. Their income was the highest in history. The costs of the materials they had to buy for living and production also went up, but not so fast as the prices they got for their crops. As a result, farmers are in the best financial condition they have been since the twenties, possibly since the last war. According to reports, they are using their improved income wisely, reducing debts and putting themselves in sound financial condition. Fortunately, they have not forgotten the headaches following their speculative land buying during the boom of the last war.

1942 has witnessed marked changes in the agricultural picture. It has seen the AAA program change almost over-night from crop restriction to crop expansion. It has seen the imposition of restrictions in the use of nitrogen fertilizers, necessitated by curtailed imports and military demands. It has seen the inauguration of a control over fertilizer manufacture that will eliminate the too large tonnage of low analysis fertilizers that were used in the past and reduce the

number of grades to those considered best suited to needs consistent with supplies of materials available. It has seen the greatest compaign for the growing of legumes for forage and as winter cover crops ever staged in North America. Some of these changes were troublesome, many very sound under any conditions.

Agriculture in 1942 has had many problems with which to contend. It met them with courage and resourcefulness. Its efforts have been successful and have been rewarded as well deserved. The reward is not only in the good financial return, but in the sense of a difficult job well done. Agriculture is in a good position to meet the greater demands and the more difficult problems appearing over the horizon of the coming year.

Legume Resources

Elsewhere in this issue we are privileged to publish an article entitled "Nitrogen for Crop Production from Winter Legumes." The author, Mr. W. F. Watkins of the U. S. Department of Agriculture, has made a significant study of the potentialities of legumes as related to the present nitrogen shortage and we are confident his message will be widely read and appreciated.

In the agricultural economy of the United States, nitrogen has from the first been closely tied up with crop production. Of all the essential nutrients it is the most difficult to supply and control. It is subject to ready losses from leaching and erosion. Crops use it in large amounts, and in the form of commercial fertilizers, it has always been the most costly of the major plant foods. Despite these handicaps, its recognized importance in soil humus and crop production makes it a constant challenge to the scientist and farmer in their efforts to maintain an adequate and continuous supply.

Faced now with a shortage of commercial nitrogen because of the diversion of vast quantities for munitions manufacture, greater stress than ever is being placed on the growing of legumes. Legumes can fix nitrogen from the air, but important as may be their contribution when grown under ideal conditions, their limitations must be recognized. The amount of nitrogen which legume bacteria can fix depends upon a number of factors. First, of course, is the necessity of having a good growth of the crop. This will require proper soil moisture, drainage, aeration and adequate supplies of calcium, potash, magnesium, phosphorus, boron, and other nutrients, proper inoculation, and necessarily a type of crop adapted to the section in which it is to be grown. While all of the nutrients are of equal importance qualitatively, since the plant will not grow well if any one is lacking, potash assumes particular significance quantitatively since the plants contain more of this than of the other nutrients. Assuming ideal conditions, alfalfa, for example, is capable of fixing up to 250 pounds of nitrogen per acre. The large growing clovers and soybeans fix only about half and the vetches, field peas, and beans from one-fifth to one-fourth as much as alfalfa.

Furthermore, whether or not a legume crop when innoculated with the right kind of bacteria makes its maximum contribution of nitrogen to the soil supply depends upon the fertility level of the soil and what part of the plant growth is plowed under. It is known that in soils already high in nitrogen, little or none is fixed; while fixation processes are at their best under low nitrogen levels and where the soils have been generously supplied with lime, phosphorus, and potash. In evaluating the benefits of legumes grown under favorable conditions, it should be remembered that only about one-third of the nitrogen is in the roots and two-thirds in the tops. It is quite obvious, therefore, that the amount of nitrogen supplied and the residual effects of subsequent crops will depend on the proportion of the plant growth returned to the soil.

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

¶ Again this month there are a number of publications issued by experiment stations revising their former fertilizer recommendations to bring them in line with the grades authorized by the Government to be sold. These publications are too numerous to review individually but will be found listed below.

¶ An interesting report of farm records on 85 demonstration farms scattered throughout North Carolina has been prepared by H. B. James and is issued as an unnumbered mimeographed pamphlet of the Farm Management Department of the North Carolina Agricultural Extension Service. This is entitled "Farm Management Demonstrations Using Potash, 1942." It is in the nature of a progress report since this large and significant program is intended to run for a number of years. The records kept by the farmers include a complete inventory, all expenses and receipts, crop production records, and related information. The data are grouped by farms in the eastern part of the State, in the Piedmont section, and in the mountains. Farms in all sections grew tobacco, corn, grain, hay, and soil-improving crops, while cotton was not grown in the mountain section and peanuts were grown only in the eastern section. In the eastern and mountain sections more acres were devoted to corn than any other single crop. In the Piedmont small grains occupied first place. The mountain farms had on an average about one unit less of livestock. Yields in the three sections of the State did not vary as much as might be expected. Cotton yielded more in the eastern than in the Piedmont section. Tobacco yields were higher from the mountain sections, mainly due to the type grown there. The mountain section also produced a somewhat higher average yield of corn. The farms in the eastern part of the State had more than double the receipts of the farms in the mountain area, with the Piedmont section intermediate. Expenses were somewhat in the same proportion. The labor income varied tremendously, being $1,300 in the eastern part of the State and minus $19 in the mountain section. The crop returns per acre were $54 in the eastern part of the State, $25 in the Piedmont, and $12 in the mountain section. On all of the farms, for the fertilization of legumes or cover crop, 10% of each field did not receive potash while the other 90% did receive potash; and the entire field was given appropriate applications of lime and phosphate. It is stated that on most farms potash produced an outstanding visible improvement in the growth of soybeans, and differences could be observed also on wheat, oats, barley, and lespedeza. The value and influence of such demonstration farms, not only in the immediate vicinity but in surrounding areas, are discussed and shown to be considerable.

"Fertilizer Recommendations for Alabama in 1943," Dept. of Agron. & Soils, Agr. Exp. Sta., Auburn, Alabama.

"Fertilizer, Feed, Lime, and Seed Report, Jan.-June 1942," State Board of Agr., Dover, Delaware.

"Fertilizers and Limestone for Permanent Pastures," Agr. Exp. Sta., Experiment, Ga., Press Bul. 514, Sept. 25, 1942, O. E. Sell.

"Nitrogen Problems in the Midwest," Dept.

of Agron., Univ. of Ill., Urbana, Ill., Nov. 3, 1942, F. C. Bauer.

"Recommendations of the Approved Grades of Fertilizer for Ky.," Agr. Exp. Sta., Lexington, Ky., Sept. 1942.

"Fertilizer Results with Tung Trees and Recommended Cultural Methods," Agr. Exp. Sta., University Station, Baton Rouge, La., Bul. 352, Aug. 1942, W. D. Kimbrough, Julian C. Miller, and W. F. Wilson.

"The Mixed Goods Fertilizer Situation," Agr. Ext. Serv., University Station, Baton Rouge, La., Oct. 1942, R. A. Wasson.

"Wartime Recommendations on the Use of Commercial Fertilizer," Agr. Exp. Sta., Columbia, Mo., Cir. 242, Sept. 1942, O. T. Coleman and A. W. Klemme.

"Water Solutions of Ordinary Mixed Fertilizers for Use in Starting and Side-Dressing Plants," Agr. Exp. Sta., New Brunswick, N. J., Cir. 449, Sept. 1942, Arthur L. Prince and Victor A. Tiedjens.

"Fertilizer Sales by Grade in Order of Tonnage Jan. 1, 1942-June 30, 1942," N. C. Dept. of Agr., Raleigh, N. C.

"Farm Management Demonstrations Using Potash," Agr. Ext. Serv., Raleigh, N. C., 1942, H. B. James.

"Fertilizer Grades for Rhode Island for 1943," Agr. Ext. Serv., Kingston, R. I., Nov. 1942.

"Summary of Fertilizers, Fertilizer Materials, and Customers' Mixtures Sold in S. C.," Clemson Agr. Col., Clemson, S. C., Oct. 1, 1942.

"Wartime Crop Fertilization in Tennessee," Agr. Ext. Serv., Knoxville, Tenn., Pub. 265, Oct. 1942, H. E. Hendricks.

"Germination of Cottonseed as Affected by Soil Disturbance and Machine Placement of Fertilizer," Agr. Exp. Sta., College Station, Texas, Bul. 616, Aug. 1942, H. P. Smith, M. H. Byrom, and H. F. Morris.

"Phosphate Reserves of Utah," Agr. Exp. Sta., Logan, Utah, Bul. 304, Oct. 1942, Rev. Est. by J. Stewart Williams and Alvin M. Hanson.

"Fertilizer Grades for Vermont in 1943," Agr. Ext. Serv., Burlington, Vt., Nov. 1942.

"Plant-Growth Regulators," U. S. D. A., Washington, D. C., Misc. Pub. 495, 1942, John W. Mitchell and Ruby R. Rice.

Soils

¶ The management of orchard soil during the war period, so as to maintain the productivity and thriftiness of orchards, is discussed in a very practical manner in Pennsylvania Agricultural Experiment Station Bulletin 431, entitled "The Orchard Fertility Problem During the War Emergency." It was prepared by the Pomology Staff of the Experiment Station. The key to the solution of this problem appears to be the maintenance of soil conditions in orchards so as to permit a good legume cover to be grown on the soil. Experiments conducted over long periods of years are quoted showing that when good legume covers are kept on the orchards, it is possible to get along without using any commercial nitrogen fertilizer and still have good trees and good yields. In many cases, the trees grown with a legume cover but no nitrogen fertilizer would out-yield trees that received nitrogen fertilizer without a legume cover crop under them. The authors bring out repeatedly that lime, phosphate, and potash must be used in adequate quantities if good legume covers are to be kept on the orchards. Lime should be applied according to the acidity and lime requirement of the soil. Superphosphate applications of 200 to 400 lbs. per acre are suggested, and the recommendation for potash calls for 50 to 200 lbs. of muriate of potash or sulfate of potash. The management of the orchard provides for cutting the legume crop or harrowing at proper times, so as to prevent undue competition between the trees and the cover crop for soil moisture and nutrients. Such management combined with proper liming and fertilization would appear to offer a practical solution to the orchard fertility problem, not only during the war-emergency period but as a general practice.

"Rainfall and Runoff in the Upper Santa Cruz River Drainage Basin," Agr. Exp. Sta., Tucson, Ariz., T. Bul. 95, Sept. 1, 1942, Harold C. Schwalen.

"Good Soil Management Is Essential for High Wartime Production," Agr. Ext. Serv., Urbana, Ill., E. Cir. 535.

"The Pixley Area California—Soil Survey," U. S. D. A., Washington, D. C., Series 1935, No. 23, April 1942, R. Earl Storie, Bruce C. Owen, M. H. Layton, A. C. Anderson, W. J. Leighty, and C. C. Nikiforoff.

"Albany and Schenectady Counties New York—Soil Survey," U. S. D. A., Washington, D. C., Series 1936, No. 16, May 1942, Clarence Lounsbury, Robert Wildermuth, W. E. Benson, and D. F. Kinsman.

"Newport and Bristol Counties Rhode Island —Soil Survey," U. S. D. A., Washington,

D. C., Series 1936, No. 18, August 1942, A. E. Shearin, S. V. Madison, and W. S. Colvin.

"The Virgin River Valley Area Utah-Arizona—Soil Survey," U. S. D. A., Washington, D. C., Series 1936, No. 13, March 1942, F. O. Youngs, O. F. Bartholomew, D. S. Jennings, LeMoyne Wilson, I. D. Zobell, M. H. Wallace, J. E. Fletcher, and William Baugh.

"Effect of Mulches and Surface Conditions on the Water Relations and Erosion of Muskingum Soils," U. S. D. A., Washington, D. C., T. Bul. 825, July 1942, Harold L. Borst and Russell Woodburn.

"Wartime Farming on the Northern Great Plains," U. S. D. A., Washington, D. C., Misc. Pub. 497, June 1942, Harry L. Carr.

Crops

¶ The influence of different fertilizer combinations on yield and longevity of the stand, on hay land, and on yield of silage corn are shown by Ford S. Prince, Paul T. Blood, and Gordon P. Percival in New Hampshire Agricultural Experiment Station Circular 61, "Fertility Needs of Dairy Farm Crops in the Connecticut Valley." Preliminary work in this area indicated the importance of potash in maintaining good yields of legumes. Additional work was inaugurated with silage corn, with the most significant increases in yield being produced by manure and superphosphate. The corn was followed by a mixed clover and timothy hay crop in which again the potash produced the greatest increase in yield, although best results usually were obtained with the combination of phosphate, potash, lime, and nitrogen. It was very noticeable that the clover persisted on the plots receiving potash but disappeared on all the other plots. The authors raised the question as to whether the persistence of clover on these plots was due to a prolongation of the life of plants or whether conditions were made favorable for the germination of seed which had been lying dormant in the soil. They seem inclined to believe that the former explained a large part of this persistence of the clover. In the work reported, potash gave the greatest net profit per dollar invested, but the greatest total net profit per acre came from the complete fertilizer treatment. In another set of plots on the same field, potash increased yield a little over a ton per acre per year, while phosphate increased yield only a little more than a tenth of a ton per acre. When the two were used together, however, the yield was increased two and one-third tons per acre per year. Thus, the lime and phosphate together increased the yield more than the sum of the increases of each one alone. The authors emphasize that owing to the importance of potash on these soils and the fact that manure can add considerable potash, great care should be taken in conserving manure. Under the best of conditions, however, there are bound to be losses, and the manure probably would not supply enough potash to meet the needs of the soil. They say, therefore, that the manure should be supplemented with potash in the same way farmers have learned to supplement the manure with phosphate. In conclusion, they state that the persistence of red clover in the stand can be used as an indication of the sufficiency of potash applications. If the clover soon dies out, it is a pretty sure indication that insufficient potash is being used.

¶ Information on the growing of peanuts in Southern Georgia is given by S. A. Parham in Georgia Coastal Plain Experiment Station Bulletin 34, entitled "Peanut Production in the Coastal Plain of Georgia." This publication brings out some of the peculiarities surrounding the fertilization of the peanut crop. The author states that peanuts do not respond as well to fertilization as other crops, which is rather remarkable considering the large amounts of plant food removed from the soil by peanuts. The crop, when harvested for nuts, has a reputation for being hard on the land, a reputation that is fully justified unless proper steps are taken to replace the nutrients by fertilization. This fertilization should involve applying nutrients for the peanut crop and higher than normal amounts for the crop following

peanuts. Based on investigations conducted at the Station, a fertilizer such as 2-10-4 or 2-10-6 at 200 to 400 lbs. per acre is recommended for the peanuts if the preceding crop was not heavily fertilized. This fertilization will help replace some of the plant food taken out by the crop, although when peanuts follow a crop that was heavily fertilized, the peanuts frequently will not respond very much to the fertilizer given. It is brought out that crops following harvested peanuts often suffer severely from potash deficiency. Therefore, unless high potash fertilizers are used for peanuts, the crop following the peanuts should receive a higher than normal potash fertilization. Information on planting, cultivation, harvesting, and diseases also is included in this publication.

"Sixty-seventh Annual Report of the Ontario Agricultural College and Experimental Farm 1941," Guelph, Ont., 1942.

"Annual Report State Board of Agriculture 1941-1942," Dover, Delaware, Sept. 1942.

"Fifty-fourth Annual Report Georgia Experiment Station," Experiment, Ga., 1942.

"How to Grow Tobacco Plants," Agr. Ext. Serv., Athens, Ga., Cir. 302, Nov. 1942, E. C. Westbrook.

"Crimson Clover for Pasture," Agr. Exp. Sta., Experiment, Ga., Press Bul. 512, Sept. 8, 1942, O. E. Sell.

"Italian Rye Grass for Pastures," Agr. Exp. Sta., Experiment, Ga., Press Bul. 513, Sept. 14, 1942, O. E. Sell.

"Emergency Crops for Dairy Cows," Agr. Ext. Serv., Hawaii, E. Cir. 140, Jan. 1942, J. C. Ripperton.

"Fifty-fourth Annual Report," Agr. Exp. Sta., Lexington, Ky., 1941.

"Annual Report of the Maine Extension Service," Univ. of Me., Orono, Me., E. Bul. 309, Nov. 1942.

"Smooth Bromegrass in Missouri," Agr. Exp. Sta., Columbia, Mo., Cir. 243, Sept. 1942, E. Marion Brown.

"Irrigation of Seed and Canning Peas in the Gallatin Valley, Montana," Agr. Exp. Sta., Bozeman, Mont., Bul. 405, Aug. 1942, O. W. Monson.

"Sweet Potato Investigations in New Jersey," Agr. Exp. Sta., New Brunswick, N. J., Bul. 697, Sept. 1942, V. A. Tiedjens and L. G. Schermerhorn.

"Produce Your Own Nitrogen," Agr. Ext. Serv., New Brunswick, N. J., E. Bul. 232, Aug. 1942, H. R. Cox.

"Better Pasture and Hay Crops," Agr. Exp. Sta., New Brunswick, N. J., Cir. 448, Aug. 1942, Gilbert H. Ahlgren and Claude Eby.

"The Vitamin C Content of New York State Vegetables," Agr. Exp. Sta., Geneva, N. Y., Cir. 196, Sept. 1, 1942, D. K. Tressler.

"Forest Grazing and Beef Cattle Production in the Coastal Plain of North Carolina," Agr. Exp. Sta., State College Station, Raleigh, N. C., E. Bul. 334, March 1942, H. H. Biswell and J. E. Foster.

"Growing Ornamental Greenhouse Crops in Gravel Culture," Agr. Exp. Sta., Wooster, Ohio, Bul. 634, Oct. 1942, D. C. Kiplinger and Alex Laurie.

"Tomato Growing and Preparing for Market," Fed. Coop. Ext. Serv., Corvallis, Ore., E. Cir. 372, July 1941, A. G. B. Bouquet.

"Plan the Vegetable Garden," Agr. Ext. Serv., State College, Penn., Leaflet 73, March 1941, Jesse M. Huffington.

"Agronomy Handbook for South Carolina," Ext. Agron. Div., Clemson, S. C., Bul. 104, Aug. 1942.

"Orchard Management," Agr. Ext. Serv., College Station, Texas, E. Bul. B-73, Rev. 1942, J. F. Rosborough and Cameron Smith.

"Making Grass Silage Without Molasses or Phosphoric Acid," Agr. Ext. Serv., Burlington, Vt., Brieflet 632, June 1942.

"A Hand Book of Agronomy," Ext. Agron. Dept., Blacksburg, Va., Bul. 97, Rev. June 1942.

"Classification of Wheat Varieties Grown in the United States in 1939," U. S. D. A., Washington, D. C., T. Bul. 795, June 1942, J. Allen Clark and B. B. Bayles.

"Effects of Partial Defoliation at Transplanting Time on Subsequent Growth and Yield of Lettuce, Cauliflower, Celery, Peppers, and Onions," U. S. D. A., Washington, D. C., T. Bul. 829, Aug. 1942, James E. Kraus.

"Winter Legumes for Green Manure in the Cotton Belt," U. S. D. A., Washington, D. C., F. Bul. 1663, Rev. May 1942, Roland McKee and A. D. McNair.

"Care of Damaged Shade Trees," U. S. D. A., Washington, D. C., F. Bul. 1896, May 1942, Rush P. Marshall.

"Distribution of the Varieties and Classes of Wheat in the United States in 1939," U. S. D. A., Washington, D. C., Cir. 634, Aug. 1942, J. Allen Clark and K. S. Quisenberry.

"Irrigation of Sugar Beets Grown for Seed," U. S. D. A., Washintgon, D. C., Cir. 658, Aug. 1942, Charles Price and M. R. Huberty.

Economics

¶ Records of farm accounts furnish valuable information on types of farming that are likely to be most profitable, and provide clues to factors influencing the profitableness of the enterprise. Data of this type are summarized in Illinois Agricultural Experiment Station Bul-

letin 491, "Twelve Years of Farm Accounts In Illinois," by P. E. Johnston and H. C. M. Case. The records cover the period 1926 to 1937 on farms in eight of the nine agricultural areas into which the State is divided. Nearly 17,000 records were analyzed in this work. The period covered years of agricultural prosperity and years of intense agricultural depression. The farms studied undoubtedly were better than the average farms in the State from the viewpoint of the operator, and the practices followed. Over the State as a whole, the average annual cash balance of receipts over expenditures of the farms varied from $958 in 1932 to $2,445 in 1929 with net income per acre on the cash basis of $1.43 in 1932 and $7.50 in 1929. These figures do not take into consideration changes in inventory which cause much wider differences. Cash expenditures per farm varied widely with prosperity of the year, amounting to $1,494 in 1933 and $3,424 in 1937. These wide differences in money expended by farmers show the influence of agricultural prosperity on the general level of prosperity of the country. The authors have analyzed the data in various ways, and the results are presented in tables and charts. Their findings are too numerous to give in detail here, but warrant careful study and consideration by farmers and their advisers.

"Labor and Power Needs on Crops in Bulloch County, Ga.," Ga. Exp. Sta., Experiment, Ga., Cir. 139, Oct. 1942, W. E. Hendrix and W. T. Fullilove.

"Annual Summary of Fruit and Vegetable Unloads in Honolulu 1941," Agr. Ext. Serv., Univ. of Hawaii, Honolulu, T. H., E. Cir. 146, April 1942.

"Twelve Years of Farm Accounts in Illinois," Agr. Exp. Sta., Urbana, Ill., Bul. 491, P. E. Johnston and H. C. M. Case.

"Marketing the Illinois Peach Crop," Agr. Exp. Sta., Urbana, Ill., Bul. 492, Sept. 1942, V. A. Ekstrom.

"Standards and Procedure for Classification and Valuation of Land for Assessment Purposes," Agr. Exp. Sta., Bozeman, Mont., Bul. 404, June 1942, H. H. Lord, S. W. Voelker, and L. F. Gieseker.

"Sugar Beet Costs and Management in Irrigated Sections of Western Nebraska," Agr. Exp. Sta., Lincoln, Neb., Bul. 341, May 1942, George H. Lambrecht and Walter L. Ruden.

"Variations in Flue-Cured Tobacco Prices," Agr. Exp. Sta., Raleigh, N. C., T. Bul. 69, May 1942, S. L. Clement.

"Income Parity for Agriculture—Part I—Farm Income," U. S. D. A., Washington, D. C., July 1942.

"The Agricultural Resources of Madagascar," U. S. D. A., Washington, D. C., For. Agr. Rpt. 7, Aug. 1942, Bertha Merdian.

"Farm Parity Prices and the War," U. S. D. A., Washington, D. C., The Farmer and the War—2, 1942.

"State and Local Government Finance in Wartime," U. S. D. A., Washington, D. C., The Farmer and the War—No. 4, 1942.

"Controlling Corn and Hog Supplies and Prices," U. S. D. A., Washington, D. C., T. Bul. 826, June 1942, Geoffrey Shepherd.

"War and Farm Work," U. S. D. A., Washington, D. C., Misc. Pub. 492, May 1942, Robert C. Tetro and Martin R. Cooper.

Scientists Say . . .

(*From page* 22)

increased yields by 2 tons per acre at Fond du Lac and 9 tons at Kenosha.

Best yields of all resulted with 200 lbs. of 3-12-12 drilled at the side of the row plus broadcast of 500 lbs. muriate of potash, 500 lbs. 20% superphosphate, and 25 lbs. borax. Such treatment increased yields 52% above the unfertilized check plots at Fond du Lac and 116% at Kenosha.

That alternate freezing and thawing usually converts some of the "fixed" potassium in soil to an available form, but in some soils has the opposite effect, is a finding made by L. O. Fine, T. A. Bailey, and E. Truog.

This investigation was prompted largely by the observation that some soils apparently contain more available potassium in the spring than during the previous fall.

When 12 soil samples were saturated with water and frozen 10 times over a period of one to two days, eight of them showed an increase in available potassium. One was affected very little, and the other three showed decreases.

This trial indicated there is no consistent relationship between the soil type and the effect of freezing and thawing. For example, a Miami silt loam pasture soil showed the largest increase, calculated to be 155 lbs. of available potassium per acre; but a rich garden soil of the same type lost the largest amount—170 lbs. per acre.

Apparently there is a tendency for freezing and thawing to increase the available potassium in most soils of moderately low fertility, as well as those to which potash fertilizer has been applied in moderate amounts. On the other hand, those with an extremely high level of available potassium may have part of it converted into a fixed form. These indications support a theory some scientists have advanced—namely, that the available potassium in soil tends to move toward a certain "equilibrium level."

Experiments with soil samples limed at the extremely heavy rate of 10 tons per acre showed that lime alone tends to slow up the liberation of potassium by freezing, and in some cases to result in a decrease of available potassium. However, applying muriate of potash along with the lime apparently allows fixed potassium to be liberated somewhat more freely.

Trials on certain clay samples treated with various salts before freezing indicated an excess of calcium chloride or sodium chloride slows down the release of fixed potassium, while the opposite is true of ammonium chloride and ammonium acetate.

These laboratory experiments in soil science must be supplemented with further research to determine whether the findings need to be considered in farm soil-building programs. At present there seems to be no reason for modifying well-established fertilization practices.

The fact that nature apparently has provided a mechanism to keep the available potassium content of soil from approaching zero is a reassuring one, but it does not mean the supply will remain at a high enough level for profitable crop production. On the contrary, the evidence of fertilization trials is that in Wisconsin the use of liberal potash applications is becoming more necessary and profitable as our farm land becomes older in terms of cropping history.

Nitrogen for Crops from Winter Legumes

(*From page* 20)

Results of experiments in Georgia covering five years, on six soil types representative of large areas of the Cotton Belt, show that "no-nitrogen" plots, treated with 0-6-3 fertilizer, produced 555 pounds of seed cotton, only 97 pounds more than the unfertilized plots. Increasing the nitrogen content of the fertilizer to 16, 32, and 48 pounds of nitrogen per acre, increased yields to 733, 967, and 1,011 pounds per acre, respectively. In four similar experiments on different soil types in Georgia and South Carolina, fertilizer containing 16 pounds of nitrogen gave an increase of 214 pounds of seed cotton over no-nitrogen. Thirty-two pounds of nitrogen produced an additional 222 pounds, or a total yield of 991 pounds; and 48 pounds increased the yield by 54 pounds more, or a total of 1,045 pounds of seed cotton per acre.

The results on four soils in the Coastal Plain and Piedmont section of South Carolina show the yield is in almost direct relation to the amount of

nitrogen applied. The use of higher levels of nitrogen on cotton on the Coastal Plain soils of South Carolina gave more profitable returns; on the Piedmont soils, there is also a gradual increase in yield with increased amounts of nitrogen, but the variations are not so wide.

On Cecil sandy loam in South Carolina the average yield of seed cotton, 1928-1940, where Austrian Peas were grown with applications of phosphoric acid and potash, was 2,324 pounds per acre; where only rye was grown, the average yield was only 1,414 pounds. The addition of 24 pounds of nitrogen on the plots growing Austrian Peas increased the yield only 202 pounds. The no-cover-crop area, side-dressed with 200 pounds of nitrate of soda, did not produce as much cotton as the winter-legume plot without side-dressing.

Soil Treatment and Nitrogen Availability

These data show that good soil treatment favorable for growing winter legumes is a very profitable farm practice from the standpoint of increasing crop yields and maintenance of soil fertility. The use of nitrogen is the principal soil treatment essential in maintaining high yields of cotton and corn from the Delta soils of the Mississippi to the Coastal Plain and Piedmont soils of Alabama, Georgia, and South Carolina. This nitrogen can be obtained from soil-building legumes or commercial fertilizer.

Some other factors must be considered in determining the sources of nitrogen for crop production. These include the cost of the nitrogen, the farm practices, the cropping system, the availability of supplies, and the type of farming.

Let us examine some of the farm problems in connection with supplying the nitrogen needed for crop production. Nitrogen in commercial fertilizers has been readily available. The cost varies, depending on the price of fertilizer, but is a cash expenditure. With fertilizer at $30 per ton, a 400-pound application could cost $6 per acre and a 600-pound application $9 per acre. In general, the cost will range from $6 to $10 per acre. The cost of applying fertilizer is not of major importance and is considered an essential farm practice. Using commercial sources of nitrogen fits into a continuous cotton-growing economy. When the cotton is picked in the fall, no field work is necessary until preparation of the land for cotton the following spring. The soil is exposed to the ravages of nature during these months and many pounds of plant food may be leached away and tons of soil washed from the sloping fields.

The growing of legumes as a source of nitrogen presents many different problems. The winter legumes must be planted in the fall, immediately after cotton picking. The seed costs $2 or $3 per acre, depending on the price and kind of legume sown. The successful growing of legumes requires the normal applications of phosphoric acid and potash, adding another $4 or $5 to the cash cost, making the total cash cost from $6.50 to $8 per acre. Financing a winter-legume program means making loans nearly a year in advance of harvesting of the cash crop, whereas financing of nitrogenous fertilizer is only from spring to fall.

The legumes grow during the winter and spring, utilizing available plant foods in the soil, and prevent the surface soil from washing down the slope, filling terrace channels, or washing completely from the field. When legumes are grown, the plans for the next year must be made in the fall, fitting into a long-time cropping system. Where the operators of land change from year to year, the plans are not made until winter or just before field work begins in the spring.

Legumes make a dense top growth which must be turned under just before crop planting. Such turning requires more power than the mere breaking of cotton stubble. The average farmer

frequently cannot turn more than half his acreage with a good growth of legumes. The top growth of legumes, however, adds large quantities of organic matter to the soil; being green, it decomposes quickly under normal climatic conditions, but this organic matter increases the water-holding capacity of the soils, reducing surface run-off. The use of tractor power on farms is helping to overcome the problem of turning legumes in the short period available. In a diversified type of farming a number of crops are grown. This reduces the peak labor and power requirements on the farm, especially during the spring period.

What about the acreage of winter legumes in the Southern and East Central States where they are generally adapted?

Winter-legume Acreage

The acreage of winter legumes should have some relation to the acreage of intertilled crops which are normally grown on about 50 million acres in this area. The total acreage of winter legumes in this area has not exceeded four million acres in any one year. Since only a percentage of the acreage can be turned in the spring in time to plant crops, all of the intertilled crops cannot be followed by winter legumes. A committee of specialists in the Department of Agriculture have established some long-time goals for winter legumes in these States as follows:

	1,000 acres
Mississippi	2,285
Alabama	1,964
Georgia	2,260
South Carolina	918
North Carolina	1,129
Florida	82
Louisiana	922
Arkansas	1,244

This represents a five-fold increase in the acreage of winter legumes. This may seem excessive, but (1) they are in line with what is considered good farm practice, (2) they conform to recommendations of State College Agronomists, (3) they are in line with soil conservation farm plans being developed in Soil Conservation Districts, and (4) they are in line with recommendations made by county planning committees. These goals are too extreme to be attained in one or two years. In the present war effort, unusually good progress will be made since many sources of commercial nitrogen have other war uses and the supply of commercial nitrogen is considerably less than the unrestricted demands.

There is also a need for increasing the acreage of winter non-legumes, principally small grains, in this area. In the war effort, with limited supplies of commercial nitrogen, this cannot be successfully attained since spring top-dressing of small grains with nitrogen fertilizer is essential to obtain reasonably high yields. In fact, in many areas of these Southern States it is not worthwhile to plant small grains if top-dressing of commercial nitrogen is not available.

The bulk of the Austrian pea and vetch seed used in these Southern States has been produced in the Pacific Northwest. Crimson clover, adapted to the northern part of the area, is successfully produced close to the source of demand. Considering the time of harvest, the marketing and transportation problems, and time involved, considerable quantities of the seed cannot reach the area sufficiently early to be planted at the most desirable time.

The importance of nitrogen from commercial nitrogen or winter legumes cannot be over-emphasized. It is necessary to obtain desired crop yields, maintain soil fertility, and prevent further soil erosion. Both sources of nitrogen are essential in a diversified system of farming. In the present war effort, legumes can be used to supplement the supply of commercial nitrogen. The acreage should be still further increased in the post-war period to increase the productivity and economy of the area.

The Place of Boron in Growing Truck

(*From page* 17)

nutrition which are exemplified in various individual crops discussed herewith.

Another crop for which boron is commercially used in Oregon is broccoli, an important crop for freezing. In 1939 over 1,000,000 pounds of this vegetable were frozen in Washington and Oregon out of a total of some 2,700,000 pounds for the United States. The symptoms of boron deficiency in broccoli are mostly cracks or splits on the underside of the petiole or stem, the leaves are very brittle, and the buds may turn brown and fall off. The use of borax in a commercial fertilizer is a standard practice in growing this crop at the present time in Oregon.

Another member of the cabbage tribe for which boron is used extensively is brussels sprouts, frozen in 1940 in the Northwest to the extent of over 500,000 pounds, which amount was about two-thirds of the national crop preserved in this manner. Symptoms of boron deficiency in brussels sprouts do not show as rapidly as on broccoli according to Chandler (8), but there are swellings on the stems, outside leaves may be curled outward and distorted, the leaves at the base of the plant fall off, and the sprouts are usually smaller. Commercial growers of sprouts in Oregon are likewise including borax in their commercial fertilizer mix.

Cabbage shows symptoms of boron deficiency in internal browning of the pith and also in certain malnutrition characters of the leaves. According to Wisconsin observations, Golden Acre is considerably more susceptible to internal pith browning than Ballhead or Hollander.

Cauliflower is not only an important crop for local market and for shipment, but it is also frozen in the Northwest to the extent of 566,000 pounds in 1940. The two outstanding symptoms of deficiency of boron in cauliflower are: First, the watery or brown stem which is oftentimes hollow; second, the discoloration of the curd or head. In his studies, however, Chandler of Maine could find no relation between boron-deficiency symptoms and hollow stems. As little as five and six pounds of borax per acre have been used in New York State to successfully control the brown discoloration and rot of cauliflower heads, which have caused serious damage to this crop. In Oregon 25 pounds of borax per acre are being included in the fertilizer mix distributed by some vegetable freezing firms.

In the case of celery, some of the early work with this vegetable has already been mentioned by the Oregon Experiment Station in sending trial amounts of borax to growers some five or six years ago. Apparently, celery has a higher tolerance for boron than many other plants, but there have been some severe cases of stem-crack in Oregon, so much so that now the application of borax is included in the fertilizer program in almost every area where celery is grown. In the Lake Labish area alone in recent years 3,000 pounds or more of this material have been applied annually.

Results From Boron Applications

In Denmark borax was used for the control of heart and dry rot of celery, and in Great Britain cracked-stem has been controlled by boron applications. In Massachusetts in 1936 several crops of celery were practically ruined by a condition of boron deficiency in certain soils, whereas the 1937 crops on the same lands were saved by boron applications. Excellent yields and high grades have been obtained by the broadcasting of 30 pounds of commer-

cial borax, and similar results have been obtained when the same amount was applied to the sides of the rows. Cracked-stem is apparently widespread all over the United States.

We come now to a vegetable, the carrot, which thus far has had comparatively little attention in its relation to boron. The canning pack of carrots in Oregon is important, frequently amounting to between 250,000 and 300,000 cases. Due to increased consumption of this vegetable, it is likewise an important market crop and is used to a minor extent in preservation by freezing. Apparently, the carrot is menaced today by the maladies common to other root crops, including beets, rutabagas, turnips, and mangels.

Boron and Carrots

K. Warrington (9) reports having observed internal breakdown of carrots, noting that symptoms were visible not only in the food and water conducting areas of the roots but also in the leaves of the plant. Warrington concluded that carrots must be added to the list of plants for which boron is an essential constituent. However, there appears to be little evidence at the present time that the internal blackening is controllable by such methods as have been used with the other root crops. Dark centers in rutabagas and turnips have been reported in a number of cases, while brown heart of swedes has been controlled in New Zealand and elsewhere by the application of 20 or more pounds of borax per acre. In carrots, the breakdown assumes symptoms of exterior canker, interior darkening, and watery cores. In some extreme cases the entire central portion of the carrot is hollow. In some cases which the Oregon Experiment Station has investigated, there is considerable similarity in the breakdown of these roots to that found in the other roots already mentioned.

The rutabaga has been investigated all over the world in regard to a study of the browning of the roots and the use of boron to counteract the trouble. With as few as 5 to 10 pounds of borax per acre, there has been a notable decrease of plants affected with brown or hollow heart. For turnips, the symptoms are virtually the same, and similar treatment would be recommended. Chandler shows that turnips have a rough surface when grown without boron, while healthy roots have a smooth surface.

Outstanding symptoms of boron deficiency expressed in spinach have not been observed at Oregon State College, but definitely higher yields per acre have been obtained with the application of 20 to 30 pounds of borax combined with the fertilizer that may be used for the crop.

A lettuce disease due to boron deficiency has shown up in the Salinas Valley in California in recent years, manifesting itself in a malformation of the leaves and the spotting and browning of the leaf tips. On soils where any one crop is affected by boron deficiency, it is recommended that borax be applied at the rate of not more than 10 pounds per acre for such a crop as lettuce.

Vegetables Sensitive to Boron

Vegetable crops have been classified by Purvis and Hanna according to their tolerance to applied borax as determined by field and greenhouse studies. Contrasting the relative sensitiveness of various vegetables, snap beans and cucumbers are very sensitive and should have on the average no more than five pounds of borax per acre. Also in the sensitive group are listed celery, muskmelons, peas, potatoes, squash, and watermelons. Those that are rated tolerant with the possible application of 30 pounds of borax per acre to correct any ailment are cabbage, carrots, corn, eggplant, kale, lettuce, onions, peppers, radishes, spinach, and sweet potatoes. Crops that are rated very tolerant and for which up to 50 pounds of borax are applied per acre include beets, cauliflower, mustard, tomatoes, and turnips.

It is important to give attention to methods of application when borax is used singly or in combination with other fertilizers. The amount of borax used per acre is one-fifth to one-tenth that of the average fertilizer, which means that there must be efficient distribution of the material to make it useful for the crop in question.

In contrasting broadcasting fertilizer and applying it as a side-dressing to the row, it should be remembered that one pound of fertilizer comes in contact with 400 pounds of soil where drilled, against one pound to 6,000 pounds broadcast and disked. It is evident, then, that when but 20 or 30 pounds of borax per acre are broadcast, there is 15 times less the concentration of fertilizer per pound of soil than in the case of the side-dressing.

Methods of Application

Methods of application of borax which have been suggested and used are as follows:

(1) Broadcast with fertilizer, using up to 50 pounds of borax per acre or possibly even more, though above that amount experimental caution should be used.

(2) Applied alongside the row 1½ to 2 inches away at seed level and at the time of seeding, using from 20 to 50 pounds of borax per acre, depending on the vegetable being grown.

(3) Used alone with no fertilizer, in which case it should preferably be mixed with sand or fine soil in the proportion of 85 pounds of filler to 15 pounds of borax per acre to make sufficient bulk and to obtain even distribution of the comparatively small amount of borax. A cyclone type of grass seed hand sower may be used.

(4) Applied in solution as boric acid solution, in which case it may be used (a) as a spray with or without insecticides or fungicides, or (b) in the barrel of a plant-setting machine.

In general, applications of borax should be made in the early life of the plant, preferably at or before seeding time or at or before plant-setting time. These early applications are particularly desirable if the crop is to depend on natural rainfall.

It seems somewhat uncertain as to the actual causes of breakdown in certain plants, such as beets, which are suffering from lack of boron.

In discussing the work of Brandenburg, Dennis and Dennis report that boron is not translocated from old to new portions of a plant but that a constant supply is necessary at all times. Brandenburg found that when the source of boron supply was interrupted the new leaves of sugar beets were very low in content of boron, while the older leaves, formed while the supply of boron was plentiful, retained the normal amount of boron. He reported that new leaves, formed under inadequate supply of soil boron, soon developed symptoms of boron deficiency.

Cook and Millar (10) in their recent publication on the effect of borax on spinach and sugar beets, state that the fact that boron once fixed within a plant is not readily translocated to other portions of the plant or to the new tissue makes the problem of fertilization with boron more interesting and important. It also makes it more difficult and probably accounts for the fact that the appearance of boron deficiency symptoms seems to have some correlation with weather conditions.

There is no doubt that within a few years the accumulation of widespread investigations will furnish much valuable information to growers of vegetables as to the actual functions of boron and the most useful ways of applying it to the soil.

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A Preliminary Study of Lodging of Oats in Missouri

(*From page* 13)

ship between the potassium and the lignin content of the samples is shown in Table 2.

Plant composition reflects very closely the mineral balance in the soil. The results of these determinations further suggest the influence of nutrient balance on plant behavior. Previous workers have reported the beneficial effects of potassium in strengthening the stems of grasses and cereals. Apparently all of these reports, however, were based upon observations of cultures in which adequate supplies of the element were compared with distinct deficiencies. It is known that nitrogen is very beneficial when the supply is in harmony with that of the other plant nutrients, but harmful effects invariably result from nitrogenous over-nutrition. Only when present in the plant in excessive amounts has nitrogen been associated with lodging of cereals. Is it not reasonable to expect that in comparison with potassium-starved plants, the plants grown with an adequate supply of potassium would show a better-balanced composition and have stronger plant tissues? If an over-supply of nitrogen is harmful to plant tissues, it is reasonable to suppose that an excess of potassium might result in various symptoms of this unbalanced condition. The results of this investigation suggest such a possibility, and substantiate the observations of Dassonville (3) that the stems of grasses growing in cultures high in potash were weak and the plants lodged. His conclusions were discounted by later workers, but, perhaps, whereas they were comparing low with adequate amounts of potassium, Dassonville was comparing a deficient with an excessive supply of the element.

In light of the conflicting conclusions of Welton on the one hand and Davidson and Phillips on the other, the lignin contents of the oat stems were estimated for comparison. The results were like those of Welton, in that he found excessive nitrogen associated with low lignin content and lodging, whereas the results presented here indicate that high potassium, low lignin, and lodging are apparently associated.

Lignin may be found to play a more important role in the plant than has heretofore been assigned to it. The amount of lignin present per unit weight of plant material may prove a primary factor in determining resistance to disease and insects, and to lodging.

Crampton (2) has suggested that the determination of lignin in forages might be a better index of their feeding value than a report on the crude fiber fraction which he has found to be relatively digestible. The apparent influence of the nutritive balance on the lignin content of plants has been suggested.

Inasmuch as this investigation was undertaken merely as a "direction pointer", only those determinations considered absolutely essential were car-

ried out. More complete and better controlled experiments are now under way that should throw more light on the relationship between potassium and the other nutrients, particularly the potassium-calcium balance and its influence on growth, composition, and behavior of the soybean plant.

The investigation reported here and the results of certain of the field experiments of the Missouri Agricultural Experiment Station * are indicating that many soils may be adequately supplied with potassium at the present levels of calcium, phosphorus, and nitrogen, and if potassic fertilizers are applied crop injury in some form may result. However, if soils are so managed that their supply of calcium, phosphorus, and nitrogen is considerably increased, potassium will undoubtedly then become the limiting factor. The present trend in Missouri and other states toward the increased use of lime, phosphates, and green manures, will in time result in a need for potassic fertilizers even on soils now apparently well-supplied with this element.

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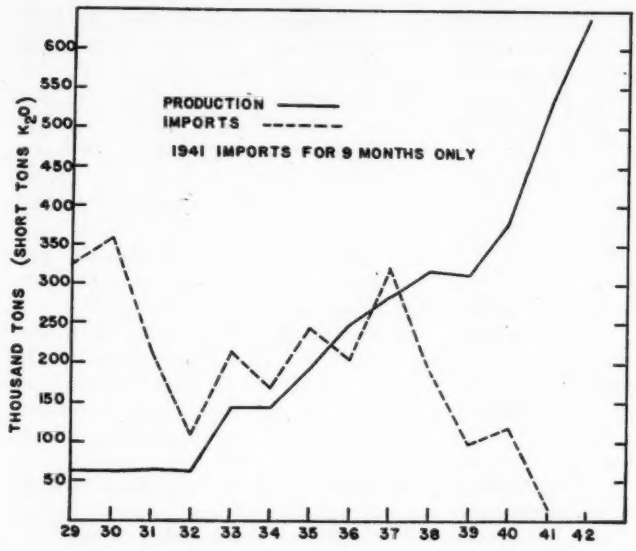
Wartime Contribution of the American Potash Industry

(*From page* 10)

in the growing of quality tobacco promptly subsided.

Likewise the interruption of European exports deprived us of our accustomed source of agricultural water-soluble "magnesia", magnesium sulfate and sulfate of potash-magnesia, both of German origin. This situation was adjusted by the last named company in the production of "washed langbeinite", an acceptable substitute for the formerly popular sulfate of potash-magnesia.

Since the major use of potash is as a



plant food essential to agriculture, the outstanding wartime contribution of the potash industry is to make possible the great expansion in certain specified lines of agriculture production called for by the Government. Foremost is food for Americans, now in a position to enjoy three full meals a day. Superimposed is food for our armies and for the United Nations, to be expanded to include food for the peoples of occupied countries when freed from their oppressors. Included are food crops susceptible of preserving and concentrating, which, if grown intensively and produced profitably, must be scientifically fertilized. Meat and dairy products are emphasized; if produced with optimum efficiency, they call for high-quality nutritive herbage (legumes and grasses) which can best be grown on properly fertilized fields and pastures. For legumes lime, phosphate, and potash are the major requirements; the nitrogen fixed by them is sufficient for their own use and for the grasses grown with them. The great value of the fertilized legume-grass pasture is being so widely demonstrated by federal and state soil conservation and other agencies as to warrant the prediction of its future permanence as an essential farm adjunct.

Then, there is the demand for a greatly increased production of vegetable oils — cottonseed, peanut, soybean, linseed, and tung; the current adequacy of potash supplies makes possible its use in the optimum amounts called for by the latest experimental data. The byproduct seed cakes or meals are available as concentrates for supplemental feeds in the livestock and dairy industries, both undergoing expansion.

The current nitrogen shortage can be neutralized to a considerable degree by the turning under, in whole or in part, of nitrogen-fixing legumes grown in rotation or, as in the South, as winter cover crops. In addition to the 30-pound per acre nitrogen equivalent which they have been shown to yield, are the collateral profits from plant-food mobilization, soil conditioning, and prevention of soil erosion and soil leaching. The advice of the slogans, "Grow your own nitrogen" and "Grow your own organics", would be futile were it not for the present adequacy of potash supplies for such farm practices, since the high potash requirement of legumes is now generally recog nized. The programs of the Soil Conservation Service for which potash is required—illustrated for example, by the current requirement of 100,000 tons of 0-14-14 fertilizer—can continue without interruption. In short, the wartime contribution of adequate potash supplies is completely meeting the requirements of a vast food program and is in contrast to those derangements and deprivations, both agronomic and eco-

nomic, which constituted the potash problem of 1914-18.

In the chemical field the wartime contribution to national independence, security, and comfort likewise has been marked with outstanding success.

Salts of potassium used in the chemical and industrial fields for the most part are derived from the chloride as the primary product. A high standard of purity is required; and to meet it, the American Potash and Chemical Corporation re-refined its high-grade muriate and thus became the first domestic source of a chemical grade of potassium chloride. Subsequently, the bulk product of the United States Potash Company was found to meet these standards and thereupon became a second source of supply. While the bulk product of the Potash Company of America is of equal percentage purity, the minute content of iron oxide to which it owes its pink color is a deterrent to its general acceptance in the chemical trade. An additional refining unit is being used by this company to give a product from which this impurity has been eliminated. Here again, the supply situation is excellent.

The advent of war in 1939, therefore, found us prepared to contribute to the emergency ample supplies of chemical grades of potassium chloride, which were susceptible to expansion. The extent of this expansion is illustrated by comparing the record of 1938, the last normal prewar year, with that of 1941. In 1938 domestic deliveries of potassium chloride to chemical industries amounted to 25,000 tons KCl and in 1941 to 83,000 tons. Imports of potash chemicals during the first nine months of 1941 amounted to only 162 long tons, exclusive of bitartrate, a by-product of the wine industry. In 1938, we imported in excess of 6,000 long tons of the chlorate and perchlorate alone. With the cessation of imports, expansion in this field received effective attention.

These chemicals and their derivatives enter into innumerable peacetime applications and into the every-day lives of most of us. It suffices to mention only the chlorates, essential constituents of the modern match.

Expansion in production to supply these normal peacetime uses had to be further increased to provide for military requirements. Among the compounds officially listed as of military importance are potassium bromide, chloride, chlorate, perchlorate, dichromate, chrome sulfate, hydroxide, nitrate, and sulfate. When their specific uses can be discussed publicly, it is to be hoped that the desirability of maintaining these manufactures as permanent sources of essential chemicals in accordance with the lessons taught by two world wars will be stressed. Quoting from "The Mineral Industry during 1940": "From the standpoint of the present emergency, perhaps one of the most gratifying developments in recent years has been the establishment of facilities for the production of essential potash chemical compounds in quantities sufficient to satisfy domestic needs."

From the former problem of what to do with our surpluses, we have changed overnight to how to make out with inadequacies. Priorities, allocations, rationing, pricefixing, and other devices to regulate supplies with maximum benefit to the war effort and minimum derangement of private lives are the order of the day.

By contrast with a situation affecting what superficially appears to be most other commodities, potash is conspicuous as an outstanding exception. To date, federal war agencies have taken the position that only minor problems exist with respect to potash supplies and publicly have expressed gratification in that fact. Official satisfaction must be multiplied many times by that of the agricultural public whose operations in this emergency are not being disrupted as they were in World War I. Foresight born of that experience has resulted in this present state of adequacy of potash supplies from our own mines and refineries. Equal foresight must be exercised if that state of independence is to be perpetuated.

The Same to You

(*From page* 5)

fellers wrong. It's like this: last week I went to visit my son in the air school barracks. I didn't see much wrong with the grub, but you oughta heard the soldiers cuss about their meals—also about lots of other discomforts in camp life. They'll do it every time, but just let any geezer start something against this country or the old flag and all heck will bust loose! That's me every time! I'm proud of this country and happy to be an American. I'm strong for all this freedom we have, includin' the freedom to speak what's on your mind and vote the way you think. I'm an American first and a storekeeper second. But I'm goin' to stick to this old shop that my Daddy started during the Spanish war—that is, I will if the bank will give me credit until I can sell that last box of tacks!"

Over at the red brick hotel with its Victorian mansard roof and dormer windows, one finds a blinking night clerk playing cribbage with the porter. We hand him three dollars and are ushered to the bridal chamber, where they keep that picture of the Stag at Bay hanging over the feather bed.

Down-stairs the cocktail lounge is rather empty of hangers-on and drinkers-down, reminding us of the old novel of our boyhood days, Ten Nights in a Bar Room.

"I'm not fretting about keeping enough liquids in stock," says the pimple-faced dispenser, "but it worries me about getting rid of it. Before gas was rationed all the boys would rush in from miles around to celebrate the latest newspaper victory, and they hung to it until the Tom and Jerry was consumed. But this year I guess they'll stay home and swig up some of that apple jack derived from a bumper crop of pippins flavored with codling moths."

"I see you opened up the old sample room," is my comment. "I thought the salesmen were off the road for keeps."

"Drummers will travel by bus and railroad now, and that means a lot of them will stay here overnight and lay out their stock awhile. They uster hurry in with their cars, park down at the curb near the stores, and grab a lunch at the Bon-Ton Cafe. Inside of an hour if business was brisk they was on their way out to the next town. What's one man's meat is another man's poison. The gas men don't like this situation, but from now on during the duration this Inn is in, believe me, as far as bed and board goes. I've sent for a brand new, red-covered railway guide and will keep it on the tobacco counter tied with string to the cigar lighter. It ain't been years since we had one of them red books around. We've took down the state road map and the file of tourist folders, 'cause it's goodnight to the summer trade. In their place, I put up a war zone atlas and a county directory."

Just to pass my patronage around a bit, I saunter down to the Bon-Ton Cafe, that erstwhile busy spot redolent of cabbage and sauerkraut flavored with onions and bacon fat. Although the heady aroma lingers still, the customers are scarce as new tires. The chap who takes my order also officiates at the kitchen range, so it is some time before I get a chance to put the bee on him about the doughnut demand.

IN answer to my query, a pained expression flits across his red face. He wipes a slight tear from one eye, which may be onion juice or sentiment, and replies:

"Too much government!" Before I can run through the alphabet signals to detect his grievance, he supplies the answer.

"This joint has always been a one-man and a one-girl service spot, plus the cook. Now I'm all alone, with five times the book work to do just to please the blamed bureaucrats. Believe it or

not, starting December 1, we have had to keep daily records of all the raw materials we bought and everything we served. Every morning I have to weigh the sugar before filling the bowls, and then weigh it again at night. The same goes for coffee, salt, baking powder, eggs, meat, soap powder, floor wax, and garbage, too. Yesterday I served only ten customers all day and spent the rest of the time washing dishes and doing my home work on them confounded inventories. I can't figure out what economic value Mr. Byrnes or Mr. Nelson sees in checking the ingredients that go through such a hole in the wall as this!" Here he broke down and staggered out of sight behind the thumb-printed kitchen door.

As neither his food nor his demeanor tended to prompt appetite or digestion, I left my meal untasted and wended my way down to the grist mill, where I was sure to meet some of my understandable cronies among the rural gentry.

And I did. For standing there in the brown stone doorway, through which generations of plowmen had taken their toll to mill, was Abner, the Upright. Tall and powerful for his seventy-odd summers of production, this sage of the soil usually kept a better balance than any of the folks in Our Town, regardless of party or parity.

"SO far most of my friends on this day have spoken discouraging words about the discord on the Home Front, Abner, and I finally hiked down this way to see if anybody had a seasonal thought or two, like the old times when we called cheerio to all and sundry at the approach of Christmas."

Abner threw back his broad shoulders, never bent by plowing or musket toting in the Spanish war, and replied softly:

"Jeff, old-timer, I'm glad you asked me that. I just got back from a big pow-wow of farm leaders and spokesmen who spend much time worrying about Washington," he said. "Maybe some of the things they said and some of the demands they made on the administration were sound and progressive, and perhaps if they hadn't hollered and kicked, we would not be in as good shape as we are to begin the battle again when the sap flows. In my own simple manner of speaking," said Abner, "it strikes me us farmers on the whole is getting a pretty fair shake. Of course, lots of our best boys are in Bataan and Bizerte just when we need 'em most. But gosh ding it, Jeff, that goes for all the sons of all the mothers and fathers around this bailiwick, and I bet you if they had begun fighting this war by a manifesto which barred the barn-yard boys, our granger gang would have raised more hell than Hitler. In every scrap since Valley Forge, it's been the farmers who prized liberty the most."

HE paused to lift a couple of heavy grain sacks back into the trailer, and then resumed:

"Since they woke up to the food shortage and the labor problem, our farm boys have been put in a special classification, either II-C or III-C. Henderson says we can keep on usin' all the gasoline and oil we reasonably need, and that makes us the favored customers of the gasoline alley lads.

"We have plenty of fuel wood on most of our farms and preserves and canned goods galore, in spite of all the yawp about sugar rations. Take it from me, rural America is set to stand a longer siege than any other section of the country. They can keep their shins toasted and their bellies full anyhow. We can eat, we can sleep, we can travel moderately, we can keep warm and dry—and our financial condition at present average prices is the best it has been since we kept cool with Coolidge. But now, Jeff, if you'll call this an interview and not misquote me, I'll drive on home and trim the tree. Best wishes and more of 'em!"

"And the Same to You," I called after him as he rattled off toward his homestead in the hills.

An elderly couple enter a magistrate's office.

Man: "I want to get married."

Magistrate: "How old are you?"

Man: "72."

Magistrate: "Why are you marrying?"

Man: "Well, I've saved up some money, so I'd like to marry and have an heir."

Woman: "I've saved up some money too, and want to marry and have an heir."

Magistrate (aside to clerk): "These people are sure more heir minded than heir conditioned."

"Jimmy, stand up and face your seat."

"Gee, teacher, I ain't no contortionist."

"Daddy, what is a mole?"

"It's a kind of wart on a person's skin."

"Do they crawl around?"

"No."

"Then that ain't a mole on your neck, is it?"

"Today I met a girl who had never been kissed."

"I would like to meet her."

"You're too late now."

Now that rubber and gasoline and time are all getting scarcer and scarcer, many a man will have to give up golf. But he can still use the words.

Lecturer: "Potts was a great man. At his death three towns were named after him—Pottstown, Pottsville, and Chambersburg."

Customer: "Gimme a tablet."

Drug Clerk: "What kind of a tablet?"

Customer: "A yellow tablet."

Drug Clerk: "But what's the matter with you?"

Customer: "I want to write a letter."

Chaplain: "My man, I will allow you five minutes of grace before the electrocution."

Condemned Man: "Fine, bring her in."

The lady wished her servant to be pleased with her new place. "You'll have a very easy time of it here," she said sweetly, "as we have no children to annoy you."

"Oh," said the colored girl generously, "I'se very fond of chilluns, so don't restrict yo'se'f on my account, miss."

HOW TRUE

First Flapper: I wouldn't wear a one-piece bathing suit; they're too immodest.

Second Ditto: I haven't much of a shape either.

CLASSIFIED AD—1942 STYLE

Owner of 1940 Ford would like to correspond with widow who owns two tires. Object, matrimony. Send picture of tires.

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Circulars

Potash Pays on Grain (South)
Greater Profits from Cotton
Tomatoes (General)
Asparagus (General)
Vine Crops (General)
Sweet Potatoes (General)
Grow More Corn (South)
Fertilizing Small Fruits (Pacific Coast)
Potash Hungry Fruit Trees (Pacific Coast)
Fertilize Potatoes for Quality and Profits (Pacific Coast)
Better Corn (Midwest) and (Northeast)
The Cow and Her Pasture (Northeast) and (Canada)
Fertilize Pastures for Better Livestock (Pacific Coast)
What You Sow This Fall (Canada)
Home-grown Grains for Profitable Hogs (Canada)
What About Clover? (Canada)
Of Course I'm Interested (Pastures, Canada)

Reprints

B-8 Commercial Fertilizers in Grape Growing
K-8 Safeguard Fertility of Orchard Soils
T-8 A Balanced Fertilizer for Bright Tobacco
CC-8 How I Control Black-spot
II-8 Balanced Fertilizers Make Fine Oranges
MM-8 How to Fertilize Cotton in Georgia
A-9 Shallow Soil Orchards Respond to Potash
N-9 Problems of Feeding Cigarleaf Tobacco
R-9 Fertilizer Freight Costs
T-9 Fertilizing Potatoes in New England
CC-9 Minor Element Fertilization of Horticultural Crops
DD-9 Some Fundamentals of Soil Management
KK-9 Florida Studies Celery Plant-food Needs
MM-9 Fertilizing Tomatoes in Virginia
PP-9 After Peanuts, Cotton Needs Potash
UU-9 Oregon Beets and Celery Need Boron
A-2-40 Balanced Fertilization For Apple Orchards
F-3-40 When Fertilizing, Consider Plant-food Content of Crops
H-3-40 Fertilizing Tobacco for More Profit
J-4-40 Potash Helps Cotton Resist Wilt, Rust, and Drought
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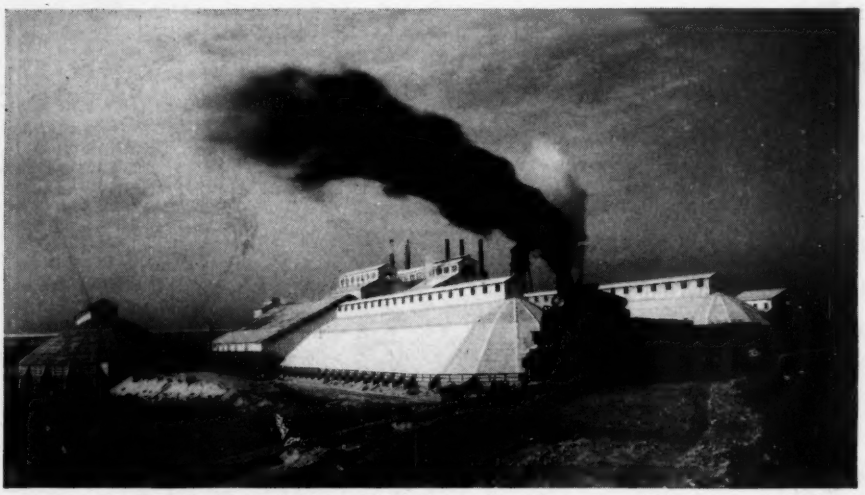

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